REMEDIAL INVESTIGATION AND FEASIBILITY STUDY FOR FALCON REFINERY SUPERFUND SITE INGLESIDE, TEXAS

QUALITY ASSURANCE PROJECT PLAN Q-Trak # 07-085

Prepared for
U.S. ENVIRONMENTAL PROTECTION AGENCY
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Dallas, TX 75202-2733

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A1 TITLE AND APPROVAL SHEET

QUALITY ASSURANCE PROJECT PLAN
FOR
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
FALCON REFINERY
SUPERFUND SITE
INGLESIDE, TEXAS

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Title: Project Coordinator

Signature: ____________________________ Date: ____________________

Name: Charles Smiroldo
Title: Quality Assurance Officer

Signature: ____________________________ Date: ____________________

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Signature: ____________________________ Date: ____________________

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A2 ABBREVIATIONS AND ACRONYMS

AA	Alternative Action
AES	Atomic Emission Spectroscopy
ALGC	Accutest Gulf Coast, Inc
ANSI/ASQC	American National Standards Institute/American Society of Quality Control
API	American Petroleum Institute
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
bbl	barrels
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Registration
CID	Criminal Investigation Division
CLP	Contract Laboratory Program
COC	Contaminant or Chemical of Concern
COPC	Contaminant or Chemical of Potential Concern
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
CSM	Conceptual Site Model
CVAA	Cold Vapor Atomic Absorption
DQO	Data Quality Objective
DS	Decision Statement
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
FM	Farm to Market Road
Forms II	Field Operations Management System II Lite
FS	Feasibility Study
FSP	Field Sampling Plan
GC	Gas Chromatography
GCC	Gulf Coast Conservation
GC/MS	Gas Chromatography and Mass Spectrometry
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
H_o	null hypothesis
H_a	alternative hypothesis
HPLC	High Performance Liquid Chromatography
HRS	Hazard Ranking System Documentation Record, Falcon Refinery
HQ	Hazard Quotient
ICP	Inductively-Coupled Plasma
ICP-MS	Inductively-Coupled Plasma – Mass Spectrometry

ICS	Interference Check Sample
IDW	Investigation-Derived Waste
IRIS	Integrated Risk Information System
IS	Internal Standards
LCS	Laboratory Control Sample
MD	Matrix Duplicate
MDL	Method Detection Limit
mg/kg	milligram per kilogram
Miller	Miller Environmental
MRL	Minimum Risk Level
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSSL	Medium-Specific Screening Level (human health)
µg/L	microgram per liter
µg/kg	microgram per kilogram
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NORCO	National Oil Recovery Corporation
NPL	National Priorities List
OMS	Odorless Mineral Spirits
OSHA	Occupational Safety and Health Administration/Act
OU	Operating Unit
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PC	Project Coordinator
PCB	Polychlorinated biphenyl
PCL	Protective Concentration Level
P.E.	Professional Engineer
PE	Performance Evaluation
PG	Professional Geologist
PID	Photoionization Detector
PPRTV	Provisional Peer Reviewed Toxicity Values
PQL	Practical Quantitation Limit
PRG	Preliminary Remedial Goal
PSQ	Principal Study Question
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
REM	Registered Environmental Manager
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RF	Response Factor
RfC	Reference Concentration
RfD	Reference Dose
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation

RPM	Remedial Project Manager
RRC	Railroad Commission of Texas
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
SOW	Statement of Work
SSL	Soil Screening Level
STSC	Superfund Health Risk Technical Support Center
Superior	Superior Crude Oil Gathering
SVOC	Semi-Volatile Organic Compound
SW-846	EPA Solid Waste Methodologies
TACB	Texas Air Control Board
TAG	Technical Assistance Grant
TAL	Target Analyte List
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TNRCC	Texas Natural Resources Conservation Commission
TPH	Total Petroleum Hydrocarbons
TWC	Texas Water Commission
UCL	Upper Confidence Limit
VOC	Volatile organic compound
VSP	Visual Sample Plan

A3 DISTRIBUTION LIST

National Oil and Recovery Corporation (NORCO) Representatives:

Name: Charles Smiroldo
Title: Kleinfelder, Quality Assurance Officer

Name: Stephen Halasz
Title: Kleinfelder, Project Coordinator

Name: Richard Bergner
Title: NORCO Counsel

Name: Tamara Welch
Title: Accutest Gulf Coast, Laboratory Quality Assurance Officer

U.S. Environmental Protection Agency (EPA)

Name: Rafael Casanova
Title: EPA Remedial Project Manager

Name: Don Johnson
Title: EPA Quality Assurance Officer

A4 PROJECT / TASK ORGANIZATION

This Quality Assurance Project Plan (QAPP) has been prepared for the Remedial Investigation / Feasibility Study (RI/FS) at the Falcon Refinery Superfund Site in Ingleside, Texas. This QAPP has been developed in accordance with the (1) Administrative Order on Consent for Remedial Investigation, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No. 06-05-04, (2) United States Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (EPA QA/R5), and (3) the national consensus standard, ANSI/ASQC E-41994.

This QAPP provides the procedures that will be employed to meet the project-specific data quality objectives (DQO) and to ensure that the quality of data (precision, accuracy, completeness, comparability, representativeness and sensitivity) are known and documented. Presented are project descriptions, organization and QA objectives associated with the sampling and analysis that will be performed at the Falcon Refinery Site.

The QA objectives include:

- Attaining the quality control (QC) requirements of this QAPP,
- Obtaining on-site and off-site data of known quality to define the horizontal and vertical extent of contamination, identifying existing and potential future receptors, assessing human health and ecological risks and considering remedial alternatives.
- Documenting the quality program including performance of the work and documentation of changes to work at the Falcon Refinery Site.

Standard Operating Procedures (SOP) are described and provided in the Field Sampling Plan (FSP) prepared for the Falcon Refinery Site.

QC procedures used in this QAPP are based on:

- Information provided by the Region 6 EPA office,
- Data provided by the Texas Commission on Environmental Quality (TCEQ), formerly the Texas Natural Resources Conservation Commission (TNRCC) and Texas Water Commission (TWC),
- Historical information from record searches,
- Information from community meetings and interviews with neighbors, and
- Scoping and project meetings with the EPA, Federal and State Trustees.

All procedures are based on available information and they may change as additional data are available. EPA approval will be obtained for major changes to the FSP and QAPP.

National Oil Recovery Corporation (NORCO) acknowledges that the EPA uses the term “Site”, which is not defined in CERCLA, in referring to a “release” or “facility” on the National Priorities List (NPL). However, for this Plan the term Site (upper case S) or on-site will be used to describe property owned by NORCO including the North Site, South Site and the Barge Dock Facility. When referring to the overall area the term site with a lower case “s” or off-site will be used. Also facility will mean property and equipment owned by NORCO or some other specified adjacent entity. NORCO recognizes that under CERCLA the terms facility and release are interchangeable.

References that are listed in this QAPP refer to the same references identified in the Falcon Refinery “Hazard Ranking System Documentation Record” (HRS) (TNRCC, February 2002). All references and project related documents may be viewed at the local repository located at:

Ingleside Public Library
2775 Waco Street
PO Drawer 400
Ingleside, Texas 78361

A4.1 Task Organization

The EPA’s Remedial Project Manager (RPM) will be the primary decision-maker for RI/FS activities conducted under the Administrative Order on Consent. The project organization chart is provided as Figure 1.

Mr. Charles Smiroldo of Kleinfelder (REM) will serve as the quality assurance (QA) Officer for the RI/FS and is responsible for the quality of all work conducted at the site. In this role he will work in an independent office from the units generating the data. Mr. Smiroldo will maintain the approved QAPP.

Stephen Halasz of Kleinfelder is the project coordinator (PC) and is responsible for all activities at the site. Accutest Gulf Coast, Inc. (ALGC) in Houston, Texas has been selected as the primary project laboratory providing all environmental analysis. Agnes Vicknair of ALGC will serve as the laboratory project manager and Tamara Welch, also of ALGC, is the laboratory QA officer. Paul Supak of Kleinfelder is the on-site manager and is responsible for all field related activities.

All subcontractors used at the site will be required to adhere to the QA/QC requirements outlined in the QAPP. Specific roles for the organization members are described below:

A4.1.1 QA Officer – Charles Smiroldo

The QA Officer is responsible for the quality of work conducted by all site and laboratory personnel. Specifically the QA Officer will:

- Review all sampling and analytical work orders;
- Randomly observe field sampling techniques;

- Coordinate with the laboratory QA Officer;
- Provide QA guidance to the project coordinator;
- Oversee all aspects of QC;
- Review all analytical data; and
- Approve the QAPP.

A4.1.2 Project Coordinator – Stephen Halasz

The PC will provide the major point of contact and control for matters concerning the project. Specifically the PC will:

- Define project objectives;
- Establish project policy and procedures to address the specific needs of the project;
- Acquire and apply technical resources as needed to ensure performance;
- Monitor and direct field personnel;
- Review work performed on each task to ensure its quality, responsiveness and timeliness;
- Approve all reports;
- Represent the project team at meetings and public hearings; and
- Approve the QAPP.

A4.1.3 On-Site Manager – Paul Supak

The On-site Manager will be responsible for leading and coordinating day-to-day activities of the field team. The On-site Manager will report to the PC and his specific responsibilities will include:

- Providing day-to-day coordination with the PC;
- Developing and implementing field-related work plans;
- Coordinating and managing field staff including subcontractors;
- Performing field audits;
- Overseeing QC for technical data provided by the field staff;
- Adhering to work schedules;
- Identifying problems at the field team level and resolving difficulties in consultation with the Project Coordinator;
- Approving the QAPP; and
- Participating in the final report.

A4.1.4 Laboratory Project Manager – Agnes Vicknair

The Laboratory Project Manager will have overall responsibility for QA/QC at the laboratory. In addition the Laboratory Project Manager will:

- Manage and provide responses to customer inquiries related to the management of the project and status of work in progress;
- Define project requirements to ensure all contract requirements are met and communicate requirements to appropriate laboratory personnel;
- Prioritize client requests based on due dates and complexity of response required;
- Manage subcontracting of samples to other ALGC laboratories and external laboratories after project startup phase;
- Generate and reviews final report to ensure accuracy. Facilitate corrective action when needed.
- Prepare report narratives.
- Prepare invoices to customers and follows up on accounts receivable; and
- Approve the QAPP.

A4.1.5 Laboratory QA Officer- Tamara Welch

The Laboratory QA Officer has the overall responsibility for data after it leaves the laboratory and will communicate issues through the Laboratory Project Manager. In addition the QA Officer will:

- Overview laboratory quality assurance;
- Overview QA/QC documentation;
- Conduct data review;
- Determine whether to implement laboratory corrective actions, if required;
- Define appropriate laboratory QA procedures; and
- Approve the QAPP.

A4.1.6 Laboratory Sample Custodian – Alisha Rodriguez

The Sample Custodian will report to the Laboratory QA Officer and responsibilities will include:

- Receiving and inspecting the incoming sample containers;
- Recording the condition of the incoming sample containers;
- Signing appropriate documents;

- Verifying chain-of-custody and correctness;
- Assigning a unique identification number and customer number and entering each into the sample receiving log; and
- Control and monitor access and storage of samples.

A5 PROBLEM DEFINITION / BACKGROUND

Limited analytical results were obtained during the data collection and reporting phase of the HRS. The information gathered at that time is not sufficient to characterize the nature and extent of any contamination. Data collected during the RI/FS phase will allow us to assess human and ecological risks posed by the site. We will then utilize that information in determining the remedial response, if one is necessary.

The on-site and off-site investigations will include two phases (Phase I and Phase II). This QAPP and its accompanying FSP address the Phase I investigation. During Phase I, investigative data will be collected. The elements of each phase for each investigation are outlined in the subsections below.

A5.1 Problem Definition

The proposed Phase I plan includes both on-site and off-site sampling of soil, sediment, groundwater and surface water. The specific sampling is described in detail in the Field Sampling Plan. Listed below is a summary of the proposed actions:

On-Site Phase I Sampling:

- Obtain 43 surface and 43 subsurface soil samples from one area of concern (AOC-1) within the former operating units (OU) and storage areas using judgmental sampling. Twelve of the locations will be from the north Site and 31 from the south Site;
- Perform random grid sampling in on-site areas that are not associated with OUs or storage areas of the refinery. Four surface and four subsurface composite samples will be mixed and obtained from 20 grid points;
- Obtain a composite surface and subsurface sample from five random grid locations at the barge dock facility;
- Install, and sample 20 temporary groundwater monitor wells in the shallow aquifer; and
- Obtain aquifer characteristics if evidence of groundwater contamination is detected.

Off-Site Phase I Sampling:

- Obtain 36 random grid sediment samples from the adjacent wetlands;
- Obtain eight judgmental sediment samples and seven surface and subsurface soil samples from locations adjacent to the underground pipelines and two former pipeline spill locations in the wetlands;
- Obtain up to 51 surface water samples from the adjacent wetlands;
- Obtain three sediment samples and three surface water samples from Redfish Bay adjacent to the barge docking facility;

- Obtain three surface and three subsurface soil samples from the neighborhood adjacent to the Refinery (Thayer Road);
- Obtain two surface and two subsurface soil samples from the neighborhood adjacent to the North Site (Bishop Road); and
- Obtain four representative background samples of soil, sediment and surface water.

Phase II Investigation

After the completion of Phase I sampling activities a scoping meeting will be held and locations for Phase II sampling will be selected. Phase II investigation could include the following activities:

On-Site Phase II Investigation

- Install, develop, and sample permanent groundwater monitor wells;
- Sample soil to complete the horizontal and vertical soil delineation (if necessary); and
- Perform aquifer testing (if necessary);

Off-Site Phase II Investigation

- Collect additional samples to characterize soil, sediment, groundwater and surface water (if necessary);
- Install, develop, and sample permanent groundwater monitor wells;
- Sample biota (if necessary); and
- Evaluate suitable remedial alternatives, if needed.

A5.2 Background

The Site consists of a refinery that operated intermittently and is currently inactive. When in operation, the refinery had a capacity of 40,000 bbls per day and the primary products consisted of naphtha, jet fuel, kerosene, diesel, and fuel oil.

The Site occupies approximately 104 acres in San Patricio County, Texas, and is located 1.7 miles southeast of State Highway 361 on FM 2725 at the north and south corners of FM 2725 and Bishop Road (Figure 2, Area Map). Another portion of the Site includes a dock facility on Redfish Bay, where materials are transferred between barges and storage tanks. The Site is bordered by wetlands to the east, northeast and southeast, residential areas to the north and southwest and construction companies to the south and north.

The Site (Figure 3, Site Map) has been owned, leased and/or operated under several different companies. The Oil and Gas Company of Texas, Inc. originally owned the Site. A deed search revealed that the facility was leased to UNI Refining, Inc., from the UNI International Corporation and the UNI Pipeline, Inc., for seven years, 1979-1986. UNI Refining Co. obtained an air permit in 1979 and commenced construction of the facility in April 1980. In March 1981, UNI Oil, Inc., the parent corporation of UNI Refining Company and UNI Pipeline Company, was sold to new owners operating under the name of Texas Independent Oil Corporation. In late 1983 to early 1984, the refinery was sold and operated under the name Mid Gulf Energy, Inc. The Falcon Refining Company purchased the Site from Texas Independent Refining facility in November 1985. In 1986, production at the refinery once again ceased, Falcon Refining, Inc. declared bankruptcy and the facility came under the ownership of American Energy Leasing, Inc. In May 1990, Impexco of Texas, Inc. acquired the Site from American Energy Leasing, Inc.

NORCO gained title to the refinery in December 1990 from Impexco of Texas, Inc. In June 1991, NORCO acquired the dock facility from the Sun Operating Limited Partnership. In the mid-90s, MJP Resources, Inc. began leasing/operating the tanks on the northwest corner of the FM 2725 and Bishop Road and the dock facility. In 1998, Pi Energy Corporation acquired 2.5 acres of the dock facility from NORCO.

Currently, Superior Crude Oil Gathering (Superior) is leasing several above ground storage tanks at the refinery portion of the Site and the docking facility, for crude oil storage and transportation; and Crude Marketing and Transportation Inc, is leasing one above ground storage tank.

The refinery, when active, processed material that consisted of not only crude oil but also contained hazardous substances, as defined by 40 CFR Part 261.32. In a Notification of Hazardous Waste Activity, signed on October 20, 1980, by Mr. Eugene W. Hodge, Vice President of UNI Refining, Inc. four hazardous wastes from specific sources were listed: K048 (dissolved air flotation float), K049 (slop oil emulsion solids), K050 (heat exchanger bundle cleaning sludge), and K051 (American Petroleum Institute (API) separator sludge). Of these sources, the listed hazardous waste K051, API separator sludge from the petroleum refining industry based on the toxicity of the sludge, was documented in an inspection report to have been deposited inside the walls of a tank berm. Other hazardous substances at the Site include: vinyl acetate detected inside two tanks during a EPA Criminal Investigation Division (CID) investigation and a TNRCC Region 14 sampling event, chromium detected in deposited cooling tower sludges and untreated wastewater release inside tank berms.

On March 12, 1986, an inspection conducted by the TWC revealed that the Falcon Refinery had disposed of cooling tower sludges on-site. These sludges were sampled and revealed Total Chromium of 8020 milligrams per kilogram (mg/kg) and EP Tox Chromium of 46 micrograms per kilogram (ug/kg). The inspector noted that, during December 1985, the Falcon Refinery made a 100,000 bbls run of slop oil, which generated a substantial amount of very odorous wastewater. The refinery’s wastewater treatment system was inoperable during this run. The refinery placed untreated wastewater in tankage and then, ultimately, discharged the untreated wastewater into sandy, unlined containment structures (firewalls). According to a 1986 inspection report, the untreated wastewater was discharged into the bermed areas around tanks 10, 11, 26, and 27. A sludge, which had been dumped inside the firewalls of tank 13, was observed and sampled during the inspection of July 1986 by TNRCC Region 14 staff. Constituents found in the sample included naphthalene, 2,4-dimethylphenol, acenaphthene, fluorene, phenanthrene, fluoranthene, pyrene, and chrysene.

On January 13, 1987, Texas Air Control Board (TACB) took a sample from a wastewater storage tank at Falcon Refining. Records indicate that the refinery received 104,000 bbl of material from Tenneco in January 1986. A substantial amount of this waste remained in the pipelines and tanks. TACB officials noted that noxious odor complaints from surrounding residents began when the refinery started processing this material. TACB concluded that the Tenneco material was not virgin petroleum, but a mixture of organic solvents and, probably, waste. TACB analytical results from a sample of material taken from a tank on January 13, 1987, support the conclusion that this material contained constituents not normally occurring in crude oil. Butanol, cyclohexanediol, 1 phenylethanol, N,N-diphenylamine, and xylene were detected in the sample of wastewater from the refinery.

An Inspection by the TACB on April 10, 1987, revealed a black, liquid substance beneath a pipeline rack on the north side of the refinery from a leak in the third pipeline (10-inch diameter) from Bishop Road. The black, liquid appeared to be either a solvent with hydrocarbon/carbon or a crude oil with solvents intermixed. The pipeline connects the tank farm in the refinery to a run-of-pipe from the docks, which were used to transfer material into and out of the Falcon Refinery tank farm. The final spill covered an area approximately 30 feet by 60 feet. Investigations on April 20 and 21, 1987 did not indicate any apparent effort to remove the spilled material, which was creating an odor problem. ARM Refining, located on the west side of FM 2725 and on the north side of Bishop Road, covered the spill on April 22, 1987.

On November 15, 1995, a spill was reported south-southeast of FM 2725 on Bishop Road, in the wetlands adjacent to the Brown & Root Facility. The spill occurred during a hydrostatic test of a pipeline prior to bringing the line back into service. The underground pipeline runs from the dock facility to the main facility. Approximately less than eight barrels of “crude oil” were spilled. According to Mr. Bernie Eickel of the Railroad Commission of Texas (RRC), the sample analyses on February 7, 1996 indicated the presence of substances other than crude oil. Two contaminated soil piles and two roll-off containers containing regulated waste associated with the spill resulted from the waste removal activity. Analyses of the February 7, 1996, samples (collected from one roll-off and liquid material leaking from the roll-off) indicated constituents not normally found in crude oil and elevated levels of the following constituents: tetrachloroethene, 2-methylnapthalene, phenanthrene, toluene, and total xylenes.

On February 16 and 19, 1996, an inspection was conducted by the TNRCC Region 14 staff at the NORCO facility in response to an alleged crude oil pipeline spill from the facility on November 15, 1995. Analysis of the spilled residuals revealed constituents not naturally occurring in crude oil. Mercury, lead, 1,2, dichloroethane, benzene, ethyl benzene, styrene, toluene, total xylenes, chrysene, m-creosol, o-creosol, p-creosol, fluorene, methyl isobutyl ketone, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene, methyl t-butyl ether, total organic halogens, and vinyl acetate were detected in the samples collected. Vinyl acetate was detected in tanks N1 and N2. Vinyl acetate is not an ingredient in crude oil nor does it substitute for other products, as it has no solvent properties, thus exempting the chemical from the petroleum exclusion.

On April 4, 1996, Jones & Neuse conducted grid sampling at the spill site. The samples were analyzed for benzene, toluene, ethyl benzene, and xylene (BTEX) and total petroleum hydrocarbons (TPH). No BTEX content was detected in the soil samples taken, but TPH levels were detected ranging from 67 to 1930 mg/kg.

The EPA CID of the Houston Area Office conducted a criminal investigation from January 1996 until August 2000 on the activities at Gulf Conservation Corporation (GCC), a facility located north of the dock facility, at the NORCO facility, which was being operated by MJP Resources, Inc. Specifically the investigation concerned a vinyl acetate slop stream delivered to GCC. According to Mr. Ronald Cady, Louisiana Department of Environmental Quality Regional Hazardous Waste Coordinator, and Mr. Brian Lynch, CID, this stream consisted of odorless mineral spirits (OMS) that were used as a carrier for the reactant in the production of polyethylene at Westlake Polymers in Sulphur, Louisiana. In this process, the mineral spirits are recycled until they become too contaminated to use and would be classed as a spent solvent. Westlake Polymers segregates the two streams and labels them V-240 (OMS) and V-242 (OMS with VA). In the past they had been classifying the mineral spirits as a co-product. The vinyl acetate is not an excluded substance under the petroleum exclusion.

Samples were collected by the CID in February 1996 from two tanks (N1 and N2), also referred to as Tanks 32 and 33 in the main processing area of the NORCO facility. The liquid samples collected revealed high concentrations of vinyl acetate in the two tanks; 1,360,000 micrograms per liter (ug/L) and 36,600,000 ug/L.

On January 4, 2000, TNRCC Region 14 inspectors completed a compliance inspection pertaining to the air quality requirements for permitted tanks. These tanks are located on the northwest quadrant of the FM 2725 and Bishop Road and are authorized in three formerly active TNRCC air permits. The naphtha stabilizer unit, located in the main processing area in the southeast quadrant of FM 2725 and Bishop Road, was observed to be leaking from a valve between the sight glass and the tank. This valve was approximately 20 feet high and the wind was blowing a shower of leaking fluid on to an area of soil and vegetation surrounding the tank. Two 8-ounce jars of sample were collected of the liquid as it leaked from the valve. Based upon the flow rate of the leak observed on January 7, 2000, and the Site inspections conducted on January 4, 6, 7, 10, and 11, 2000, it was determined by the TNRCC Region Office that a total volume of at least 220 gallons of material had leaked from the tank.

Groundwater at the NORCO facility has been contaminated as a result of the above-described release, per the March 7, 2000, report. Laboratory analyses received by the TNRCC Region 14 Office on February 25, 2000 revealed the following constituents: 1,2 dichloroethane, 4-methyl-2-pentanone (Ref. 38, p. 180), benzene, ethyl benzene, m- and p-oxylenes, styrene, and toluene (Ref. 38, pp. 44-50). The analyses also revealed that the fluid sample exceeded the maximum concentration of benzene for toxicity characteristic using the Toxicity Characteristic Leaching Procedure (TCLP).

The hazardous substances identified on-site included such chemicals as nitric acid, acetic acid, cupric chloride, potassium chromate, silver nitrate and potassium hydroxide. Additionally, the EPA believes that hazardous wastes and residues identified by the RCRA waste numbers D002, K049 and K051 are also present. All of the hazardous wastes and substances are “hazardous substances” as defined by Section 101(14) of CERCLA, 42 U.S.C. § 9601(14), and CFR § 302.4.

On April 4, 2002, there was a spill of approximately 20 gallons of crude oil on property owned by Offshore Specialty Fabricators (Reference C on the CD provided by the EPA describing spills). The spill was in the wetlands north of Sunray Road. On July 29, 2002 the Texas Natural Resources Conservation Commission (TNRCC; now the Texas Commission on Environmental Quality, TCEQ) issued a letter to Mr. Dickey Henderson (Offshore Specialty Fabricators, Inc.), which indicated that the apparent cause of the release was a series of abandoned pipelines on Offshore Specialty’s property. A RRC report dated April 4, 2002, states that employees dug a hole approximately twelve (12) feet deep and found no clean sand. Samples of the liquids present at the spill site, taken by the RRC on April 15, 2002, were analyzed and revealed the presence of vinyl acetate. A RRC report dated April 16, 2002, states that additional seepage was found from suspected unknown pipelines approximately 10 feet from the water of the salt marsh on the north end of Sunray Road. According to the RRC report, the lines were suspected to be UNI (a previous owner of the Falcon Refinery) lines.

On September 20, 2002, after a heavy rain, Tank 7 from the North Site overflowed and between 500 gallons and 500 bbls of crude oil (the document record includes both amounts) was estimated to have been spilled. The crude oil filled the bermed area around the tank and spread to the east toward FM 2725. The spilled material migrated across FM 2725 and eventually flowed within the drainage ditch toward Bishop Road and then followed the drain ditch east along Bishop Road. Some of the crude oil and water that traveled along the drainage ditch was deposited on Thayer Road and a residence. Much of the impacted area has since been paved.

NORCO hired Miller Environmental (Miller) to respond to the release and Miller used vacuum trucks and absorbent pads to remove as much of the spilled material as possible. After the free liquid was removed, Miller excavated the impacted soil, sampled the area and replaced the soil. Sampling of the soil met TCEQ closure requirements. Reports describing the release are included in Appendix A.

During 2004, after heavy rain, a sheen was noted in the drainage ditch across Bishop Road from the North Site.

Heavy rain also caused Tanks 26 and 27 at the refinery to overflow, spilling oily waste onto the ground. Since that time NORCO has been removing the contents of the tanks and they are both approximately 20% full at the time of the submission of this work plan and there is no chance that the tanks will overflow.

A6 DESCRIPTION OF PROJECT AND TASKS

The conceptual site model (CSM), shown schematically in Figure 4a, incorporates information obtained through review of project documents and available data. Preliminary contaminants of potential concern (COPC) for the site were identified from the document record, which is predominantly comprised of the HRS prepared by the TNRCC for the EPA in February 2002.

The COPCs from the HRS include metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides and herbicides. Areas of concern (AOC) have been assigned and are listed in Table 1 and depicted in Figure 5.

Objectives of the project include:

- Define the nature and extent of contamination, if any;
- Identify source areas that may continue to contaminate the site;
- Obtain background data;
- Assess risk to human receptors;
- Assess risk to ecological receptors; and
- Evaluate suitable remedial alternatives, if needed.

When the FSP is approved, an updated schedule will be developed and Appendix J (Project Schedule) of the Draft Final WP will be updated and included in the FSP and provided to the EPA.

To obtain the samples described in Table 2, the following tasks will be performed:

- Soil sampling to include surface and subsurface sampling to define the extent of contamination, if any, provide data for human health and ecological risk assessments and select a remedy, if needed;
- Groundwater sampling to determine COPCs, if any, and to delineate the extent of contamination, if any, provide data for human health and ecological risk assessments and select a remedy, if needed;
- Sediment and surface water sampling to determine the nature and extent of contamination, if any;
- Surface water sampling to determine COPCs, if any, and to delineate the extent of contamination, if any, provide data for human health and ecological risk assessments and select a remedy, if needed;
- Background soil and sediment sampling;
- Logging of soil borings to define the lithology; and
- Obtaining access agreements for off-site sample locations.

A7 QUALITY OBJECTIVES AND CRITERIA

The EPA developed the Data Quality Objectives (DQO) Process to assure that the appropriate type, quantity, and quality of data needed to support the decision are obtained. The project team developed this DQO plan, which will be iterative as additional data are obtained.

Systematic Planning Using the Data Quality Objectives Process is one of a series of quality management documents that was used to prepare this report. Other related documents included:

- *EPA QA/G-4 Systematic Planning using the DQO Process*
- *EPA QA/G-5S Guidance on Choosing a Sampling Design for Environmental Data Collection*
- *EPA QA/G-9R Data Quality Assessment: A Reviewer's Guide*
- *EPA QA/G-9S Data Quality Assessment: Statistical Methods for Practitioners*

Also, Visual Sample Plan (VSP) was used in the DQO process.

A7.1 Data Categories

This element describes quality specifications at two levels:

- At the level of the decision or study question; and
- At the level of the measurements used to support the decision or study question.

For this project, both screening-level and definitive data will be obtained to describe the two elements described above. Table 3 describes the screening and analytical methods for sampling. Only definitive data will be used in the development of risk assessments.

Screening for the site will be limited to the use of a photoionization detector (PID) for soil and sediment and a water quality meter for general groundwater and surface water parameters. Procedures for use and data collection are described in SOPs. If additional sampling is necessary and the COPCs have been defined, future sampling may include on-site soil screening. If soil screening is used then the DQO process will be amended.

ALGC in Houston will perform all the fixed-laboratory services for the RI/FS.

A7.2 Data Quality Objectives (DQO)

The QA objective for the project is to assure that procedures used for field sampling, chain-of-custody documentation, laboratory analysis and reporting provide results that are of a known quality which can be used for the RI, human and ecological risk assessments and the FS.

The DQO process used in this RI follows "Data Quality Objectives Process for Hazardous Waste Site Investigations" EPA QA/G-4HW. The seven step iterative process provides a systematic approach for defining the criteria that a data collection design should satisfy including: when, where and how to collect samples; determination of tolerable decision error rates and the number of samples that should be collected.

A7.2.1 Step 1 - State the Problem

Within Step 1 the planning team was selected and scoping meetings were held, the CSM was developed and available resources and constraints were described.

A7.2.1.1 Identify Members of the Planning Team

The planning team consists of the EPA RPM, EPA regional staff, EPA technical staff, State of Texas and Federal Trustees, NORCO personnel and representatives, the PC, Kleinfelder technical staff, city and county officials and judges, and the Coastal Bend Bay Foundation, the recipient of the technical assistance grant (TAG).

The EPA's RPM will be the primary decision-maker for RI/FS activities conducted under the Administrative Order on Consent.

Additional team members may be added as needed.

A7.2.1.2 Develop the Conceptual Site Model (CSM)

Conceptual Site Models (CSMs) for human and ecological receptors have been developed; these are based on the results of preliminary site investigations and other data. Both are summarized in the CSM Flowchart for Human & Ecological Receptors (Figure 4a), which shows potential exposure and migration pathways and receptor scenarios to be considered in developing human health and ecological risk evaluations for site contaminants under existing and future conditions. The CSM Schematic for Human Receptors (Figure 4b) and the CSM Schematic for Ecological Receptors (Figure 4b) depict the general features of these exposure scenarios in a non-technical manner designed to be readily comprehended by any viewer. The CSMs, the CSM Flowchart, and the CSM Schematics will be refined as necessary during implementation of the Data Quality Objectives (DQO) Process.

The CSM for the project includes:

- Locations of contaminant/waste sources or locations where contamination exists;
- Types of contaminants;
- Potentially contaminated media and migration pathways; and
- Potential human and ecological receptors.

Shown in Table 1 are the three on-site and four off-site areas of concern (AOCs). The off-site AOCs correspond to the adjacent wetlands, two neighborhoods and Redfish Bay (which adjoins the current barge docking facility).

In the early phases of investigation activities, data are obtained to establish which complete exposure pathways exist for each medium and land-use combination. In general, the planning team will:

- Identify currently contaminated media to which individuals or sensitive ecosystems may be exposed;
- Identify contaminants of potential concern (COPCs) based on historical site use, analytical data, and anecdotal information;
- Define the current and future land use;
- Determine the Applicable or Relevant and Appropriate Requirements (ARARs) for the site; and
- Identify available toxicity values for all COPCs and assemble the values along with the information obtained in the previous steps into exposure scenarios that represent the highest exposure that could reasonably occur at the site.

A7.2.1.3 Specify Available Resources and Constraints

Constraints include the fact that NORCO is not an operating company but in essence an individual, and monetary resources must be continually evaluated and taken into consideration. Weather events may impose constraints on sampling, thereby increasing costs. The fact that some sampling locations are not controlled by NORCO may also impose a constraint on sampling.

A7.2.2 Step 2 – Identify the Decision

There are four activities in this step:

- Identify the principal study question;
- Define the alternative actions;
- Combine the principal study question and alternative actions into a decision statement; and
- Organize multiple decisions.

A7.2.2.1 Identify the Principal Study Question (PSQ)

The principal study question (PSQ) for the Falcon Refinery RI is:

Where do levels of preliminary COPCs exist either on- or off-site at concentrations above or below risk-based screening levels (RBSLs) and/or background concentrations along complete exposure pathways for relevant exposure scenarios?

Additional study questions:

- Where are COPC concentrations above or below human and ecological risk-based screening levels?
- What are the potential migration and exposure pathways and do the data indicate a possibility of COPCs being released from the site?
- What is the distribution of COPC risk drivers at the Site, which will be used to determine the appropriate statistical parameters and the minimum number of samples required for Phase II of the Remedial Investigation and Feasibility Study?

A7.2.2.2 Define Alternative Actions

The planning team will identify alternative actions (AA) that may be taken based on the outcome of the study and that correspond with the selected principal study question. In this early phase of the project, alternative actions may include:

- Recommending that the site requires no further evaluation (AA-1);
- Recommend that the some areas or pathways should be further assessed (AA-2);
- Recommend that risks to human health or ecological receptors be further assessed (AA-3);
- Recommend that adjoining facilities should be further assessed (AA-4); or
- Recommend a response action (AA-5).

A7.2.2.3 Consequences of Incorrectly Taking an Alternative Action

AA #	Alternative Action	Error if AA Incorrectly Taken	Consequences of Error	Severity of Consequences
1	No further action	Contaminated site left unabated.	Potential risk to human health and environment.	High
2	Additional assessment	Clean site undergoes additional sampling	Unnecessary financial impact	Moderate
3	Additional risk calculation	Clean site undergoes additional calculation	Unnecessary financial impact	Moderate
4	Adjoining facility assessment	Clean site undergoes additional sampling	Unnecessary financial impact	Moderate
5	Response Action	Clean site undergoes remedial action	Unnecessary financial impact	Moderate

A7.2.2.4 Decision Statement (DS)

Decision Statement (DS) #1: Determine the nature and extent of any COPC on the refinery property that is present at concentrations above or below risk-based screening levels and/or background concentrations along complete exposure pathways for relevant exposure scenarios and requires remedial action or no further action.

DS #2: Determine the nature and extent of any COPC in the wetlands, bay or neighborhoods adjacent to the refinery that is present at concentrations above or below risk-based screening levels and/or background concentrations along complete exposure pathways for relevant exposure scenarios and requires remedial action or no further action.

A7.2.3 Step 3 – Identify Inputs to the Decision

The purpose of this step is to identify the informational inputs needed to support the decision statement and to specify which inputs will require environmental measurements. This information is necessary so that the proper data are collected to resolve the decision statement. To collect data that will be useful to resolve the decision statement, the planning team should identify what attributes are essential. The action level, such as a soil screening level (SSL), PRG or ARAR, is another important input that will be considered during this step.

A7.2.3.1 Identify the Information Required to Resolve the Decision Statement

Informational inputs necessary to resolve the decision statement include:

- **Mapping of specific on-site areas and locations to identify those requiring quantification of COPCs –** The HRS and site inspections have identified several areas of former operations and spills located at the refinery and along pipelines from the refinery. Complaints by neighbors have indicated additional areas of potential concern.
- **Determining concentrations of COPCs in all media of concern in each AOC –** Preliminary analytical results have identified VOCs, SVOCs, and metals at concentrations above laboratory detection limits. Approved laboratory sampling techniques will next be employed to obtain more precise concentrations of reported COPCs.. As instructed by EPA, "Concentrations will be compared to appropriate screening levels and background samples and the appropriate risk assessments, required by the NCP, will be performed."
- **Determining potential contaminant migration pathways –** Mapping will include site features, surface water drainage patterns, areas receiving complaints, and areas of visibly impacted soil. Also the hydrogeology will be defined to determine groundwater flow direction and determine if any impacted groundwater is leaving the refinery. Sediment and surface water in the wetlands and bay will also be evaluated.

A7.2.3.2 Determine the Sources for Information Identified

The following information sources will be utilized:

- HRS Documentation Record, Falcon Refinery;
- The 81 references cited in the HRS;
- Files related to spills in the area that were not included in the HRS;
- On and off-site inspection data;
- Recent and historical aerial photographs;
- Door-to-door survey information regarding spill information and water well information;
- Information from former managers and workers at the facility;
- Regulatory files for adjacent facilities; and
- Topographic and highway maps.

A recent EPA directive entitled 'Human Health Toxicity Values in Superfund Risk Assessments' (OSWER Directive 9285.7-53; December 5, 2003) revises the recommended hierarchy of human health toxicity values originally presented in the EPA's guidance document entitled 'Risk Assessment Guidance for Superfund' (Volume I; Part A; Human Health Evaluation Manual; OSWER 9285.7-02B, EPA/540/1-89/002, December 1989).

The Integrated Risk Information System (IRIS) remains in the first tier (Tier I) of the recommended hierarchy as the generally preferred source of human health toxicity values. IRIS generally contains reference doses (RfDs), reference concentrations (RfCs), cancer slope factors, drinking water unit risk values, and inhalation unit risk values that have gone through a peer review and the EPA's consensus review process. IRIS normally represents the official Agency scientific position regarding the toxicity of the chemicals based on the data available at the time of the review.

The second tier (Tier II) is the EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs), which are available by request to EPA Region 6. Generally, PPRTVs are derived for one of two reasons. First, the Superfund Health Risk Technical Support Center (STSC) is conducting a batch-wise review of the toxicity values in the Health Effects Assessment Summary Tables (HEAST), now a Tier III source. As such reviews are completed, those toxicity values will be removed from HEAST, and any new toxicity value developed in such a review will be a PPRTV and placed in the PPRTV database. Second, Regional Superfund offices may request a PPRTV for contaminants lacking a relevant IRIS value. The STSC uses the same methodologies to derive PPRTVs for both.

The third tier (Tier III) includes other sources of information. Priority should be given to sources that provide toxicity information based on similar methods and procedures to those used for Tier I and Tier II, contain values which are peer reviewed and available to the public, and are transparent about the methods and processes used to develop the values. Consultation with the STSC or headquarters' program office is recommended regarding the use of the Tier 3 values for

Superfund response decisions when the contaminant appears to be a risk driver for the site. In general, draft toxicity assessments are not appropriate for use until they have been through peer review, the peer review comments have been addressed in a revised draft, and the revised draft is publicly available.

Additional sources may be identified for Tier III. Toxicity values that fall within the third tier in the hierarchy include, but need not be limited to, the following:

- The California Environmental Protection Agency toxicity values are peer reviewed and address both cancer and non-cancer effects.

- The Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs) are estimates of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure. The ATSDR MRLs are peer reviewed.

- HEAST toxicity values are Tier III values. As noted above, the STSC is conducting a batch-wise review of HEAST toxicity values. The toxicity values remaining in HEAST are considered Tier III values.

A7.2.3.3 Identify the Information Needed to Establish the Action Level

Screening-level analyses will be performed to identify which of the site-related chemicals tentatively identified during preliminary analyses must be evaluated further for human health and ecological risks.

To identify COPCs for human-health endpoints, reported concentrations will be compared to EPA Region 6 Medium-Specific Screening Levels (MSSLs) and TCEQ Tier 1 PCLs. For non-cancer effects the hazard index should not be greater than 1. For cancer effects carcinogens will be evaluated at a risk range of 1.0×10^{-4} to 1.0×10^{-6}. In other words, we will identify the subset of COPCs for which the cancer risk for any receptor is greater than 1 in 100,000 (one subset of COPCs) or between 1 in 100,000 and 1 in 1,000,000 (another subset of COPCs). For COPCs with cancer risks between 1.0×10^{-4} and 1.0×10^{-6} we will make recommendations pertinent to a risk management decision based on our understanding of the chemical’s toxicology and site-specific exposure pathways.

EPA Region 6 and TCEQ ecological screening levels will be used for water, sediment and soil.

A7.2.3.4 Confirm the Appropriate Analytical Method

SW-846 Methods will be used for both inorganic and organic constituents. Table 2 provides the appropriate method for each contaminant of potential concern (COPC).

As part of the selection process for COPCs, media-specific detection limits are compared with media-specific regulatory screening levels. The purpose of this comparison is to determine whether a given COPC's detection limit is sufficiently low to ensure that at exposure levels below the detection limit (i.e., nondetects only) there will be no non-cancer health hazards or elevated cancer risks in any exposed receptor. Contaminants not excluded by comparison with an appropriate screening level will be evaluated according to the full BHHRA process.

In Appendix B, media-specific detection limits for the VOCs, SVOCs, metals, polychlorinated biphenyls (PCBs), pesticides, and herbicides that might reasonably be anticipated to be present at an oil refinery or a site for hazardous waste disposal (both applicable to the Falcon Site) are compared to media-specific ecological screening criteria derived from sources such as TCEQ ecological benchmarks, USEPA ambient water quality criteria, USEPA ecological soil screening criteria (Eco-SSLs), among others as indicated within the Appendix.

In Appendix C, media-specific detection limits for the VOCs, SVOCs, metals, polychlorinated biphenyls (PCBs), pesticides, and herbicides that might reasonably be anticipated to be present at a site used as an oil refinery or for hazardous waste disposal (both of which apply to the Falcon Site) are compared to EPA Region 6 Human Health Media-Specific Screening Levels (MSSLs), TCEQ Tier 1 Protective Concentration Levels (PCLs), and EPA Maximum Contaminant Levels (MCLs) for drinking water.

A7.2.4 Step 4 – Define the Boundaries of the Study

The purpose of this step is to clarify the site characteristics that the environmental measurements are intended to represent. The set of circumstances that will be covered by the decision include:

- Spatial conditions or boundaries of the site or release that define what should be studied and where samples should be taken; and
- Temporal boundaries that describe what the time frame of the study data should be and when the samples should be taken.

A7.2.4.1 Define the Sample Population of Interest

The sample population refers to the following media, each of which will be sampled during the RI:

- On-site (refinery property) soil and groundwater; and
- Off-site soil, sediment and surface water.

A7.2.4.2 Define the Spatial Boundary

For Phase I of the RI, the spatial boundary includes all DS #1 on-site (refinery property) and DS #2 off-site AOCs as depicted in Figure 5. On-site activities will focus on soil to a depth of approximately eight feet below ground surface (bgs), which is the anticipated depth to groundwater in the shallow aquifer based on monitor well logs from an adjacent facility.

The off-site investigation will focus on surface and subsurface soil, sediment and surface water. After the results of the initial phase of sampling are completed, a decision will be made whether to include additional off-site areas.

A7.2.4.3 Define the Temporal Boundaries

- Data will be obtained in a period of approximately five-months. On-site and off-site investigations will be conducted simultaneously. Criteria that may affect the temporal boundaries include substantial rainfall and flooding in the wetlands and on-site.

A7.2.4.4 Define the Scale of Decision Making

Decisions during the RI will be made based on the following area scales:

- On-site – where the initial decision-making scale will be based on judgmental sampling.
- On-site – where the decision-making scale will be based on composite random start systematic grid samples.
- Groundwater investigation – where the decision-making scale will be to go to the next water-bearing zone based on findings in the overlying shallow zone.
- Off-site wetlands investigation – where the decision-making scale will be the wetlands adjacent to the Site and the wetlands that lead to the bay, based on random start systematic grid samples.
- Off-site pipeline investigation – where the decision-making scale will be the pipelines that leave the refinery and connect to the current and former barge dock facility, based on judgmental sampling.
- Off-site soil investigation – where the decision-making scale will be two adjacent neighborhoods, based on judgmental sampling.
- Off-site sediment investigation (bay) – where the decision-making scale will be the sediments in Redfish Bay adjacent to the current and former barge docking facilities based on judgmental sampling.
- Off-site surface water sampling – where the decision-making scale will be surface water in the wetlands and bay, based on judgmental sampling and site conditions.

A7.2.4.5 Identify Practical Constraints on Data

Potential on-site constraints that may hinder sampling include:

- Presence of buildings, above ground storage tanks, above ground piping and former process equipment may prevent some soil and groundwater sampling;
- Active crude oil storage and transportation operations;
- Active removal action operations; and
- Underground utilities and piping may prevent sampling.

Potential off-site constraints that may hinder sampling include:

- Restricted access to property by land owners;
- Flooding and drought in the wetlands; and
- Underground utilities.

A7.2.5 Step 5 – Develop a Decision Rule

The purpose of this step is to build on the previous components of the decision-making framework established in earlier steps of the DQO Process. Specifically, the planning team:

- Specifies the statistical parameters that characterize the sample population for the medium of interest;
- Specifies the action level for the decision;
- Confirms that the action level is above measurement detection limits so that reliable comparisons can be made; and
- Combines the statistical parameter, the scale of decision-making, and the action level into an unambiguous decision rule that addresses the contamination problem.

A7.2.5.1 Specify the Statistical Parameters that Characterize the Population

Based on previous analytical results and reports of spills and releases, media to be evaluated under risk exposure scenarios include soil, sediment, groundwater and surface water. EPA Region 6 Human Health Medium-Specific Screening Levels (MSSLs), TCEQ Tier 1 PCLs, national primary drinking water standards and both EPA and TCEQ medium-specific ecological benchmarks will be used to define contaminants of potential concern (COPCs).

Background samples were gathered in the HRS investigation. However these data were determined by the project team to be inadequate for use in making decisions for Phase I of the RI. After the Phase I data are analyzed the HRS data will be incorporated into the overall analysis. Analytical data from background sampling is available in the HRS.

Based on the HRS, several preliminary COPCs and media are of interest and several exposure paths exist. Media to be evaluated under risk exposure scenarios include soil, sediment, groundwater and surface water.

EPA risk-based screening approaches will be applied to the investigation. During the Phase I assessment the approach will be a comparison of maximum observed concentrations to EPA Region 6 Human Health MSSLs (EPA 2002a), TCEQ Tier 1 PCLs (TCEQ 2007) and medium-specific ecological benchmarks (TCEQ 2006) to refine the list of COPCs.

For Phase I of the RI, the parameter that characterizes each population (medium) is the measured concentration in that medium. In subsequent phases, if the sample size is adequate, the parameter to characterize each population (medium) will include the 95-percent upper confidence level for a given exposure area. If the sample size is inadequate, then the maximum concentration should be used as the parameter to characterize each population (medium). For Superfund risk assessments, required by the NCP, the concentration term in the intake equation is an estimate of the arithmetic average concentration for a contaminant based on a set of site sampling results. Because of the uncertainty associated with estimating the true average concentration at a site, the statistically-derived 95 percent upper confidence limit (UCL) of the arithmetic mean should be used for this variable. The 95 percent UCL provides reasonable confidence that the true site average will not be underestimated. When determining maximum concentrations and 95% UCLs we will consider the size of the exposure area in accord with TCEQ guidance (TCEQ 2002).

The EPA's UCL exposure point concentration guidance document entitled "Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites" (OSWER 9285.6-10, December 2002) updates the May 1992 UCL guidance and provides alternative methods for calculating the 95% UCL. The statistical methods described in this guidance for calculating UCLs are based on the assumption of random sampling.

For sampling of surface waters and sediments we will ensure that depositional areas are targeted and that receptor exposure pathways are taken into account, in accord with TCEQ guidance (TCEQ 2002),

For the Phase I investigation, because of the possibility of other naturally occurring and anthropogenic sources of COPCs other than the Site, background sampling is included. The mean concentration of the background results for soil and sediment will be compared to the mean of the similar depositional concentration to determine if site concentrations are statistically different from background concentrations. Background results from the HRS may be used in this analysis.

A7.2.5.2 Identify the ARARs

CERCLA §121(d) specifies that on-site Superfund remedial actions must attain federal standards, requirements, criteria, limitations, or more stringent state standards determined to be legally applicable or relevant and appropriate to the circumstances at a given site. Such ARARs are identified during the remedial investigation/feasibility study (RI/FS) and at later stages during the remedy-selection process. For removal actions, ARARs are identified whenever practicable depending upon site circumstances. To be applicable, a state or federal requirement must directly and fully address the hazardous substance, the action being taken, and other circumstances pertinent to the site. A requirement which is not applicable may be relevant and appropriate if it addresses problems or pertains to circumstances similar to those encountered at a Superfund site.

Both chemical-specific and location-specific ARARs will be identified during the RI process and will be discussed with the project team during the Phase I scoping meeting after the Phase I data are gathered and the screening-level analysis is complete. Sources of chemical-specific ARARs include:

- Safe Drinking Water Act (42 U.S.C. 300(f)):

   - Maximum Contaminant Levels (MCLs) for chemicals, turbidity, and microbiological contamination; applicable to drinking water for human consumption (40 CFR 141.11-141.16).
   - Maximum Contaminant Level Goals (MCLGs) (40 CFR 141.50-141.51, 50 FR 46936).
- Clean Water Act (33 U.S.C. 1251).
- Requirements established pursuant to sections 301 (effluent limitations), 302 (effluent limitations), 303 (water quality standards, including State water quality standards), 304 (Federal water quality criteria), 306 (national performance standards), 307 (toxic and pretreatment standards, including Federal pretreatment standards for discharge into publicly owned treatment works, and numeric standards for toxics), 402 (national pollutant discharge elimination system), 403 (ocean discharge criteria), and 404 (dredged or fill material) of the Clean Water Act, (33 CFR Parts 320-330, 40 CFR Parts 122, 123, 125, 131, 230, 231, 233, 400-469).
- Marine Protection, Research, and Sanctuaries Act (33 U.S.C. 1401).
- Toxic Substances Control Act (15 U.S.C. 2601).
- TCEQ regulatory guidance (TCEQ 2002) on developing protective concentration levels (PCLs) for COPCs in surface water and sediment for the protection of human and ecological receptors according to Texas Risk Reduction Program Rule 24 (TRRP-24).
- TCEQ regulatory guidance (TCEQ 2002) on developing source media PCLs for COPCs in soil and groundwater that may be released to surface water and sediment for the protection of human and ecological receptors according to TRRP-24.

A preliminary list of potential location-specific federal ARARs is presented below in Table A7.2.1.2A.

Table A7.2.1.2A. Potential Location-Specific Federal ARARs

Location	Citation
Within 100-year floodplain	40 CFR 264.18(a)
Critical habitat upon which endangered species or threatened species depend	Endangered Species Act of 1973 (16 USC 1531 et seq.) 50 CFR Part 200, 50 CFR part 402 Fish and Wildlife Coordination Act (16 USC 661 et seq.)
Wetlands	Clean Water Act section 404; 40 CFR Parts 230, 33 CFR Parts 320-330.
Within coastal zone	Coastal Zone Management Act (16 USC 3501 et seq.)

Following is a preliminary list of the chemicals of potential concern (COPCs) that have been detected on or near the site and for which we expect to identify chemical-specific and location-specific ARARs. The chemicals are organized by chemical class into three categories: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. Maximum contaminant levels (MCLs) have been identified for the chemicals that are underlined and these values are provided in Appendix C.

- **VOCs:**
  Benzene, Butanol, Cyclohexane, Cyclohexanediol, 1,2-Dichloroethane, Ethylbenzene, Ethyl ether, Hexane, Isopropylbenzene, Methyl ethyl ketone, Methyl isobutyl ketone, 4-methyl-2-pentanone, Methyl tert-butylether, N-diphenylamine, N-propylbenzene, 1-phenylethanol, Styrene, Tetrachloroethylene, Toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, Vinyl acetate, and Xylenes.
- **SVOCs:**
  Acenaphthene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene, Benzo(a)pyrene, Chrysene, 2,4-Dimethylphenol, Fluoranthene, Fluorene, Indeno(1,2,3-cd)-pyrene, 2-Methylnaphthalene, 2-Methylphenol, 3-Methylphenol, 4-Methylphenol, Naphthalene, Phenanthrene, and Pyrene.
- **Metals:**
  Aluminum, Arsenic, Chromium, Copper, Lead, Manganese, Mercury, Nickel, Thallium, Vanadium, and Zinc.

A7.2.5.3 Specify the Risk-Based Screening Level for the Decision

Screening levels will be evaluated using the sources described in Section A7.2.3.2 of this report and will be evaluated to the potential ARARs listed in Section A7.2.5.2. The following criteria will be used to specify the risk-based screening levels:

- Industrial exposure scenarios will be used on-site. The Site will be deed recorded to only allow industrial uses for the land unless sampling data indicate that the Site meets residential criteria.
- EPA Region 6 residential MSSLs and TCEQ Tier 1 residential PCLs, whichever are more stringent, will be used for off-site human health exposures.
- TCEQ ecological screening levels will be used for off-site water, sediment and soil.

A7.2.5.4 Confirm that the Risk-Based Screening Levels Exceed Measurement Detection Limits

Table 2 provides the analytical method that will be used for each COPC. The practical quantitation limits for the listed methods are typically below the EPA Region 6 MSSLs, TCEQ PCLs and TCEQ ecological benchmarks as shown in Appendix B and C.

A preliminary analysis of analytical method requirements has been conducted. Quantitation limits associated with each analytical method have been compared to human health and ecological benchmark values.

In identifying analytical needs for the human health risk assessment, EPA Region 6 MSSLs based on residential soil exposure and ingestion of tap water (as published on December 14,

2006) were compared to SW-846 reporting limits for "low" soil and "low" water, respectively. In addition, MSSLs were also compared to "low" water and "low" soil using selective ion monitoring analysis (SIM). EPA's MSSLs (revised 5/04/07) are based on achieving an excess cancer risk of 1.0×10^{-6} or a non-cancer Hazard Quotient of 1.

For non-detected COPCs where the detection limits exceed the cancer or non-cancer screening values (1.0×10^{-6} excess cancer risk or a Hazard Quotient of 1, respectively), the concentration will be reported as ½ of the detection limit and compared to the cancer or non-cancer screening values, as appropriate, and carried forward into the risk assessment. Discussions will be held with the EPA's risk assessors concerning these situations, which will also be described in the uncertainty analysis section of the HHRA and ERA. Because of the lack of historical data regarding the COPCs there is no way to forecast which chemicals might fall into this category; therefore the planning team agreed to evaluate the data as it becomes available.

A7.2.5.5 Combine the Outputs and Develop the Decision Rule

The decision rules for the Phase I of the site RI are as follows:

Horizontal delineation determination will be made on-site through the use of judgmental sampling in the OU areas of the Site and random grid sampling in the on-site non-OU areas of the facility. As a result, the Site boundary serves as the horizontal boundary. If outer perimeter samples are found to be above the appropriate risk-based screening level and background concentrations, then off-site sampling will be performed in addition to listed off-site sampling locations during Phase II. Off-site sampling at property not controlled by NORCO will be screened to residential standards. If concentrations are below risk-based screening levels or background levels, then the horizontal extent will be defined.

Vertical delineation determination will be determined through the sampling of soil borings or through the use of a Geoprobe®. Sample intervals will include a surface soil sample and a subsurface soil sample to determine the depth of impact based on PID readings, visual observation, the groundwater interface and risk assessment parameters.

Groundwater delineation of the shallow aquifer will be accomplished through the gauging and sampling of the temporary monitor wells. Potentiometric surface elevation data will be used to determine the groundwater gradient and direction. Analytical results will be compared to COPCs and if perimeter monitor wells have concentrations that exceed the appropriate risk-based human health or ecological risk level and the background concentration, then off-site monitor wells will be installed. Otherwise, if concentrations are found to be below risk-based levels or site-specific background levels, then the horizontal extent will have been defined.

If the temporary monitor wells have COPCs that exceed the appropriate risk-based human health or ecological concentration then permanent monitor wells will be installed during Phase II.

If COPCs that have a specific gravity in excess of 1.0 are detected in the groundwater, then additional sampling of deeper aquifers may be required, unless sufficient thicknesses of impermeable sediments are documented between the shallow aquifer and the next deeper unit.

Wetlands delineation of any COPCs will be based on the random grid sampling plan in the FSP. Results from the sampling will be compared to risk-based residential human health screening levels, ecological levels and site-specific background levels. If samples are found to be above the appropriate risk-based screening level and background concentrations, then additional wetlands sampling will likely be performed.

A7.2.6 Step 6 – Specify Tolerable Limits on Decision Error

The purpose of this step is to specify quantitative performance criteria for the decision rule expressed as probability limits on potential errors in decision-making. The probability limits on decision errors specify the level of confidence desired in conclusions drawn from site data.

In this step, the following activities will be conducted:

- Determine possible range of parameters of interest;
- Define both types of decision errors and their potential consequences and select the baseline condition;
- Specify a range of possible parameter values where the consequences of a false negative decision are relatively minor (gray region); and
- Assign probability values to point above and below the risk-based screening level that reflect the tolerable probability for the occurrence of decision errors

A7.2.6.1 Determine the Parameters of Interest

Based on knowledge of activities at the site and analytical data, the parameters of interest are metals, VOCs, SVOCs, PCBs and pesticides/herbicides. The list will be evaluated after the completion of Phase I of the RI.

A7.2.6.2 Define Decision Errors, Potential Consequences and the Baseline Condition

The probability of making a decision error can be controlled by adopting the scientific method of hypothesis testing. The decision error resulting in the most severe consequence is used to establish the null hypothesis (H_o), which is the condition of the site that is assumed to be true unless the data convincingly demonstrate otherwise. The alternative hypothesis (H_a) states the opposite of the null hypothesis. For example, suppose the decision not to clean up a contaminated site has more severe consequences than the decision to clean up an uncontaminated site. In this case, the null hypothesis would be that the site was contaminated. This assumption will be maintained unless the sample data convincingly demonstrate otherwise.

A decision error occurs when the decision-maker rejects the null hypothesis when it is true, or fails to reject the null hypothesis when it is false. The terms “false-positive” and “false-negative” are sometimes used to describe these types of decision error. Statisticians refer to false-positive and false-negative decision errors as “Type I” and “Type II” errors, respectively, or as α and β errors respectively.

If the decision-maker assumes a site is clean until proven to be contaminated (i.e., H_o = site is clean; H_a = site is contaminated), then a false-positive error would be concluding a clean site is contaminated, and a false-negative error would be concluding a contaminated site is clean. On the other hand, if the decision maker assumes that a site is contaminated until proven to be clean (i.e., H_o = site is contaminated; H_a = site is clean), then a false-positive error would conclude that a contaminated site is clean, and a false-negative error would conclude that a clean site is contaminated.

The four boxes below represent the four hypothetical conditions that may exist when environmental decision-making is based on environmental measurements and the true condition of the site is not known. The two gray boxes in the figure indicate the conditions where erroneous decisions are made, and the two white boxes indicate the conditions where correct decisions are made.

The true condition is that the site is contaminated. The data show that the site is contaminated. **Data lead to a correct decision.**	The true condition is that the site is not contaminated. The data show that the site is contaminated. **Data lead to an erroneous decision that is costly in terms of unnecessary cleanup.**
The true condition is that the site is contaminated. The data show that the site is not contaminated. **Data lead to an erroneous decision of no remedial action, which leads to increased risk to human health and environment.**	The true condition is that the site is not contaminated. The data show that the site is not contaminated. **Data lead to a correct decision.**

To avoid an erroneous decision based on a false negative, our H_o for the site is that the site is contaminated.

A7.2.6.3 Specify a Gray Region

The gray region is one component of the quantitative decision performance criteria that is specifically used to limit impractical and non-feasible number of samples. The gray region is a range of true parameter values within the alternative condition near the Action Level where it is "too close to call." This gray region is where sampled data may correctly reject the baseline condition, but the sampled data frequently does not provide sufficient evidence to be overwhelming. In essence, the gray region is an area where it is not considered feasible to control the false acceptance decision error limits to lower levels because the high costs of sampling and analysis outweigh the potential consequences of choosing the wrong course of action. For this Site, the width of the gray region will be discussed during Phase II of the RI/FS. The gray region will be represented on the lower boundary by a value chosen by the Site Team and on the upper boundary by the appropriate screening level. Decisions to remediate any portion of the Site will be based on the HHRA and the ERA, required by the NCP, and not on the exceedance of screening levels.

A7.2.6.4 Assign Probability Values to Points Above and Below the Risk-Based Screening Level

A decision-error limit is the probability that a decision error may occur for a specific value of the parameter of interest when making the decision using sampled data. This probability is an expression of the tolerance for uncertainty, but does not imply that a decision error will occur.
Probability values are points assigned above and below the risk-based screening level, either human health or ecological screening level, that reflect the decision maker's tolerance for uncertainty, but it does not imply that a decision error will occur. Based on the selected tolerable limits, the VSP program will be used to evaluate the feasibility of the selected limits on error. As a baseline for determining the limits on error, concentrations of COPCs both on- and off-site will be obtained from historical and Phase I sampling results. In the assessment of the sample number, using the VSP program, the appropriate screening levels will be used as the screening limit.

A7.2.7 Step 7 – Optimize the Design for Obtaining Data

Activities in this step include:

- Reviewing existing environmental data;
- Developing general data collection design alternatives;
- Calculating the number of samples to be taken; and
- Selecting the most resource-effective data collection design.

A7.2.7.1 Review Existing Environmental Data

Outputs from the previous DQO steps were reviewed to develop the data collection design in the following ways:

- Inputs, boundaries, and decision rules were used to determine the type, location, number and timing of samples;
- Limits on decision errors will provide information for selecting the number of samples to be collected and the number of analyses per sample.

In addition, data collected from several different historical sampling events provided limited information to be used in the design step.

A7.2.7.2 Develop General Data Collection Design Alternatives

In this step general data collection designs were evaluated by the project team and a combination of judgmental, random-start sampling grid and composite methods were selected based on site-specific information.

Records are available that describe spills and releases at the Site. In addition, visual contamination is evident. Based on the facts the project team selected judgmental sampling in areas with historical releases and random-start grid sampling in areas for which there was insufficient data to choose specific sampling points.

The project team recognized that judgmental sampling will result in sampling design that is biased conservatively. However, given the data, judgmental sampling was chosen in certain instances. TRRP guidance on statistical methods and assumptions will be consulted regarding the design of sampling protocols (*Determining Representative Concentrations*, RG-366/TRRP-15).

For areas without release information the planning team decided to focus on a systematic grid sampling approach using a random-start sampling grid. This sampling scheme was the most practical and efficient sampling approach to achieve the off-site RI sampling objectives. This random/systematic approach would (1) achieve a uniform spread of sampling points, (2) easily define the largest unsampled area, (3) permit uncomplicated collection of stratified samples for the investigation of vertical extent, and (4) be easy to apply in the field.

Judgmental sampling was also chosen:

- In the wetlands along the pipelines that connect the refinery to the former and current barge dock facilities;
- In Redfish Bay to obtain samples adjacent to the former and current barge dock facilities; and
- In residential areas to ensure sampling at areas where COPCs had been observed.

Surface water sampling locations will be selected in the field based on conditions encountered on the sampling day.

A7.2.7.3 Select the Sample Size that Satisfies the DQO

Limited data, consisting predominantly of the data from the HRS are available to determine the appropriate sample size and since the goal of the HRS was different that that of the RI the data were not appropriate to determine sample size.

As a result, the number of samples to be obtained in each AOC was determined by the Site Team. After the data from the Phase I RI are reviewed, an analysis will be made in VSP to determine if an adequate number of samples exist and the DQO process will be reexamined. Described in this section are the numbers of samples for each AOC, determined by the Site Team for Phase I.

AOC-1

AOC-1 is comprised of the North Site and the OU portions of the South Site; each will be discussed in this section.

There are 12 judgmental sampling locations (J-01S through J-12S) at the North Site, to characterize possible contamination in the soil as a result of releases from product storage, pipelines, the former oil and fuel storage racks, storm water run-off, the adjoining Plains site and a former surface impoundment.

> Due to the shallow depth of the groundwater, which is anticipated to be less than eight feet, two soil samples will be obtained for laboratory analysis from each boring. Samples will be obtained from the surface 0.0 to 0.5 feet and from the interval with the highest PID reading. In the event that there are no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Samples will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs and pesticides/herbicides as shown in Table 3. Each boring will be advanced a minimum of five feet below the initial contact with groundwater.

There are 31 judgmental sampling locations (J-13S through J-43S) at the South Site to characterize possible contamination in the soil as a result of releases from product storage, pipelines, drums, debris, storm water run-off, an aeration pond and spent soil placed in berms. Past releases and inspections are described in Section A5.2 of this report.

> Due to the shallow depth of the groundwater, which is anticipated to be less than eight feet, two soil samples will be obtained for laboratory analysis from each boring. Samples will be obtained from the surface 0.0 to 0.5 feet and from the interval with the highest PID reading. In the event that there are no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Samples will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs and pesticides/herbicides as shown in Table 3. Each boring will be advanced a minimum of five feet below the initial contact with groundwater.

The planning team also used judgmental sampling in the selection of the locations for the 20 temporary monitor wells, which include six at the North Site (TW01-01, TW01-02, TW01-07, TW01-08, TW01-11, TW01-12) and 14 at the South Site (TW01-13, TW01-14, TW01-17, TW01-18, TW01-27, TW01-33 through TW01-41). Groundwater samples will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs and pesticides/herbicides as shown in Table 3.

AOC-2

There are 20 random start grid sampling locations (G-01S-G-20S) selected at AOC-2 (by VSP), which is comprised of non OU areas of the Site that have no history of releases. Composite samples will be obtained from five adjacent samples locations resulting in four surface and four subsurface samples from the AOC.

Samples will be obtained from the surface 0.0 to 0.5 feet and from the interval with the highest PID reading. In the event that there are no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Samples will be analyzed in a fixed laboratory for metals, VOCs and SVOCs. Each boring will be advanced a minimum of five feet below the initial contact with groundwater.

AOC-3

There are 36 random start grid sampling locations (G-21SD through G-56SD) selected at AOC-3 (by VSP), which is comprised of the wetlands extending from the refinery to the Intercoastal Waterway (Redfish Bay). Sampling will be performed to characterize possible contamination in the sediment as a result of releases from the Site and releases from pipelines in the wetlands.

Samples will be obtained from the sediment, or soil if sediments are not present, in the 0.0 to 0.5 foot interval and will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs and pesticides/herbicides as shown in Table 3.

The project team also selected eight judgmental sediment sampling location in the wetlands (J-44SD through J-46SD and J-54SD through J-58SD). Also seven judgmental soil sampling locations were selected (J-47S through J-53S) For the judgmental soil samples, in addition to surface samples, a subsurface sediment sample will also be obtained.

Up to 51 surface water samples will be obtained from soil and sediment sampling locations that are submerged.

AOC-4

There are 5 random start grid sampling locations (G-57S through G-61S) selected at AOC-4 (by VSP), which is comprised of the current barge dock facility for the Site. There is no history of releases at this AOC. Composite samples will be obtained from the five adjacent samples locations resulting in one surface and one subsurface sample from this AOC.

Samples will be obtained from the surface 0.0 to 0.5 feet and from the interval with the highest PID reading. In the event that there are no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Samples will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs, and pesticides/herbicides as shown in Table 3. Each boring will be advanced a minimum of five feet below the initial contact with groundwater.

AOC-5

There are 3 judgmental sampling locations (J-59SD through J-61SD) in the Redfish Bay to characterize possible contamination in the sediment and surface water as a result of releases from the current and former barge dock facilities.

Samples will be obtained from the sediment in the 0.0 to 0.5 foot interval and will be analyzed in a fixed laboratory for metals, VOCs and SVOCs, as shown in Table 3.

Surface water samples will be obtained from the sampling locations and will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs, and pesticides/herbicides as shown in Table 3.

AOC-6

AOC-6 is comprised of the neighborhood along Thayer Road.

There are 3 judgmental sampling locations (J-62S through J-64S), to characterize possible contamination in the soil as a result of releases from product storage, pipelines, the former oil and fuel storage racks, storm water run-off and a former surface impoundment.

Due to the shallow depth of the groundwater, which is anticipated to be less than eight feet, two soil samples will be obtained for laboratory analysis from each boring. Samples will be obtained from the surface 0.0 to 0.5 feet and from the interval with the highest PID reading. In the event that there are no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Samples will be analyzed in a fixed laboratory for metals, VOCs and SVOCs, PCBs, and pesticides/herbicides as shown in Table 3. Each boring will be advanced a minimum of five feet below the initial contact with groundwater.

AOC-7

AOC-7 is comprised of the neighborhood along Bishop Road.

There are 2 judgmental sampling locations (J-65S through J-66S), to characterize possible contamination in the soil as a result of releases from product storage, pipelines, the former oil and fuel storage racks, storm water run-off and a former surface impoundment.

Due to the shallow depth of the groundwater, which is anticipated to be less than eight feet, two soil samples will be obtained for laboratory analysis from each boring. Samples will be obtained from the surface 0.0 to 0.5 feet and from the interval with the highest PID reading. In the event that there are no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Samples will be analyzed in a fixed laboratory for metals, VOCs and SVOCs, PCBs, and pesticides/herbicides as shown in Table 3. Each boring will be advanced a minimum of five feet below the initial contact with groundwater.

A7.2.7.4 Select the Most Resource-Effective Design that Satisfies the DQO

Based on prior analytical sampling and historical information concerning the site, the design outlined in Table 3 provides the most resource-effective design for the DQOs for this phase of the project.

The sampling design was chosen by the project team during scoping meetings.

A7.2.7.5 Document the Operational Details in the FSP and QAPP

All items in this QAPP and the accompanying FSP provide documentation of the final design and discussions of the key assumptions that support the sampling design.

A7.3 Quality Assurance Objectives for Measurement Data

This section addresses the level of QC effort and the QA objectives for the data quality indicators of sensitivity, accuracy, precision, completeness, representativeness, and comparability of data. **Table 6** presents the acceptance criteria for definitive off-site laboratory data for chemical analyses of investigation samples.

A7.3.1 Sensitivity

The QA objective for sensitivity is expressed in the form of the method detection limit (MDL) or quantitation limit for the analytical method selected. The required analyte quantitation limits are based on the method specified practical quantitation limits (PQL). PQLs reflect the influences of the sample matrix on method sensitivity and are typically higher than detection limits. The required PQLs for investigation sample analysis are equal to the CRQLs for SVOCs, VOCs, PCBs, and pesticides (although the latter is not a COPC) and the CRDLs for total metals analysis.

A7.3.2 Accuracy and Precision

Accuracy, which is the degree of agreement between an observed value and an accepted reference value, is typically expressed as percent recovery from spiked samples or bias with respect to a reference standard. The use of spiked samples permits a constant check on method accuracy and provides an indication of the degree of matrix effect.

Establishing a sound sampling strategy and following appropriate SOPs will increase accuracy for field sampling. Field QC samples that are collected to measure accuracy include trip blanks, field duplicates, and equipment rinsate blanks. Other QC samples, such as matrix spike (MS), matrix spike duplicate (MSD), and laboratory duplicate samples, are laboratory QC samples. Accuracy for laboratory analyses will be assessed by collecting and analyzing the types of QC samples presented in Table 7 and evaluating the results against the criteria listed there.

Precision measures the variability of a measurement system. It is estimated typically by using duplicate and replicate measurements, and is expressed in terms of relative percent difference (RPD). For field sampling, precision is increased by following SOPs and by using identical sampling procedures to collect all samples. Field QC samples that are collected to measure precision include duplicate field samples and collocated samples.

Precision for laboratory analyses will be measured by collecting and analyzing the types of samples presented in Table 6 and evaluating the results against the criteria listed there.

A7.3.3 Completeness, Representativeness, and Comparability

Completeness is measured by comparing the amount of valid data obtained to the total number of measurements needed to achieve a specified level of confidence in decision-making. After analytical testing, the percent completeness will be calculated. The completeness objective for field and laboratory data is 90 percent.

Representativeness expresses the degree to which data accurately and precisely represents (1) a characteristic of a population, (2) parameter variations at a sampling point, (3) a process condition, or (4) an environmental condition. Representativeness is a qualitative parameter that depends on the proper design of the sampling program and proper laboratory protocol. Each sample collected from the site is expected to be representative of the population or environmental condition from which it was collected.

During development of the sampling network, the following were considered: (1) past waste disposal practices, (2) existing analytical data, (3) current and former on-site physical setting and processes, and (4) construction requirements. Representativeness will be satisfied by (1) ensuring that the project-specific QAPP is followed, (2) ensuring that samples are collected in accordance with appropriate SOPs or ensuring that proper sampling techniques are used when SOPs are not available, (3) following proper analytical procedures, and (4) ensuring that required holding times are not exceeded in the laboratory.

Comparability expresses the confidence with which one portion or set of data can be compared to another. Generally, comparability will be attained by achieving the QA objectives, presented in this QAPP, for sensitivity, accuracy, precision, completeness, and representativeness. Comparability of data will also be attained by following field and laboratory procedures consistently for individual sites.

A8 SPECIAL TRAINING AND CERTIFICATION

The main training requirements for project personnel involved in field activities are the emergency response and hazardous waste operations training requirements that are defined in Title 29 of the CFR Part 1910.120. All project personnel and subcontracted personnel meet the specialized training and certification requirements for completing the environmental data collection tasks that are described in this QAPP.

The project coordinator will be responsible for ensuring compliance with training and certification requirements. Training will be provided by certified training contractors.

A9 ANALYTICAL DATA DOCUMENTATION AND RECORDS

This section describes the data reporting requirements for project personnel and subcontracted laboratories that submit field and laboratory measurement data. Laboratories will analyze the samples in accordance with the EPA SW-846 protocols and submit CLP-like hardcopy and an electronic deliverable format of VOC, SVOC, pesticide, PCB, and total metals data. Data packages will include all applicable documentation for independent validation of data and verification of the DQOs. Other tests, including organic and inorganic analyses (such as pH, remedy suite analyses, and investigation-derived waste analyses), so the following documentation will be required for full data validation, if applicable:

- Case narratives, which will describe all QC nonconformances that are encountered during the analysis of samples in addition to any corrective actions that are taken;
  - Statement of samples received;
  - Description of any deviations from the specified analytical method;
  - Explanations of data qualifiers that are applied to the data; and
  - Any other significant problems that were encountered during analysis.
- Tables that cross-reference field and laboratory sample numbers;
- Chain-of-custody forms, which pertain to each sample delivery group or sample batch that is analyzed;
- Laboratory reports, which must show traceability to the sample analyzed and must contain specified information;
  - Project identification;
  - Field sample number;
  - Laboratory sample number;
  - Sample matrix description;
  - Dates and times of sample collection, receipt at the laboratory; preparation, and analysis; and
  - Description of analytical method and reference citation;
  - Results of individual parameters, with concentration units, including second column results, second detector results, and other confirmatory results, where appropriate;
  - Quantitation limits achieved; and
  - Dilution or concentration factors.
- Data summary forms and QC summary forms showing analytical results, if applicable;
  - Samples;
  - Surrogates;
  - Blanks;
  - Field QC samples;

    - Laboratory control samples (LCS);
    - Initial and continuing calibrations; and
    - Other QC samples.
- Laboratory control charts;
    - Raw data;
    - Instrument printouts; and
    - Laboratory bench sheets for preparation of samples.
- MDL study results; and
- Electronic data.

B1 SAMPLING PROCESS DESIGN

Sampling activities for the project are described in the site-specific FSP, which discusses the sample network design and rationale, including (1) the types of samples to be collected, (2) sampling locations, (3) sampling frequencies, (4) sample matrices, and (5) measurement parameters.

The sample network design and rationale was coordinated with the DQO process as described in Section A7 and presented in Table 3, which summarizes the sampling design discussed in the FSP and outlines the sampling scheme for investigation samples, remedy samples, and IDW.

QA objectives for the sampling and analysis program are as follows:

- Obtain samples that are representative of the media that are being sampled;
- Obtain a sufficient number of samples to make informed RI decisions;
- Obtain a sufficient amount of representative analytical data to meet sampling objectives;
- Obtain measurements that are of acceptable quality for the intended use of the data;
- Analyze samples using methods that are appropriate for the intended use of the data; and
- Obtain analytical data of a sufficient amount and quality to evaluate human health and ecological risks.

Because the sampling design scheme is fully discussed in the FSP and in Section A7 of this document, no further discussion is required in this section.

B2 SAMPLING METHODS

Sampling methods and equipment were selected to meet project objectives. The field sampling team will collect samples in accordance with methods described in the site-specific FSP and the procedures outlined in the SOPs listed in the FSP. The FSP describes (1) sampling methods and requirements, (2) methods that will be used to select sampling locations for various matrices, and (3) sampling equipment. The site-specific FSP describes procedures for providing unique sample identification numbers, which will enable personnel to correlate analytical results and field information with sampling locations and field monitoring stations.

If failures in the field sampling or measurement systems are detected then Kleinfelder will implement corrective actions in these situations. In general, corrective actions for field sampling and measurement failures include recalibration of instruments, replacement of malfunctioning measurement instruments or sampling equipment, and repeated collection of samples or repetition of measurements.

B2.1 Sample Container, Volume, Preservation, Holding Time Requirements and Detection Limits

Table 5 specifies the required sample volume, container type, preservation technique, and holding time for each analysis that is to be conducted on each sample matrix that is to be analyzed. The table addresses all sample matrices and provides information for organic and inorganic parameters in each matrix.

Required containers, preservation techniques, and holding times for field QC samples, such as field duplicates, field blanks, trip blanks, and matrix spike (MS)/MSD samples, will be the same as for field samples.

B3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Each sample will be traceable from the point of collection through analysis and final disposition to ensure sample integrity. Sample integrity helps to ensure the legal defensibility of the analytical data and subsequent conclusions. The team will use standard EPA procedures to identify, track, monitor, and maintain the chain of custody for all samples. These procedures are as follows:

- Field chain-of-custody procedures
    - Field procedures
    - Field logbooks
- Laboratory chain-of-custody procedures

B4 ANALYTICAL METHODS REQUIREMENTS

Analytical methods are specified on Table 2 and justified through the DQO process. Analytical methods recommended for guidance by the EPA for fixed location laboratories are listed in SW-846. The following procedures will be used to prepare and analyze soil and waste samples for this project. The reporting limits (RLs), QC procedures and data validation guidelines are provided. Analytical methods, method detection limits (MDL) and RLs are presented in Appendix B and C.

If an analytical system fails, the QA officer will be notified, and corrective action will be taken. In general, corrective actions will include stopping the analysis, examining instrument performance and sample preparation information, and determining the need to re-prepare and reanalyze the samples.

Laboratories will conduct definitive laboratory analysis of samples. Table 2 lists the laboratory analytical methods for this project. In all cases, appropriate methods of sample preparation, cleanup, and analyses are based on specific analytical parameters of interest, sample matrices, and required quantitation limits.

Modifications to analytical methods that may be required to handle atypical matrices or to achieve low quantitation limits are presented in this section. Decisions regarding the use and type of method modifications will be made during the procurement of laboratories, since different laboratories have equipment and SOPs that produce varying quantitation limits.

B4.1 Metals

Total TAL metals will be analyzed in all matrices collected for this project. Dissolved metals analysis in addition to total metals will be conducted on surface water samples for the ERA. Samples will be analyzed using inductively-coupled plasma (ICP) atomic emission spectroscopy (AES), ICP mass spectrometry (ICP-MS), and cold vapor atomic absorption (CVAA) techniques. Table 2 lists the recommended analytical technique for each metal; however, many ICP AES instruments may be capable of achieving the required PQL without use of the ICP-MS, so the laboratory will be given the option to use either technique, as long as the required PQL is achievable. Mercury will be analyzed by cold vapor technique (CVAA).

Contaminants will be (1) transferred from the solid and aqueous sample matrices to the aqueous phase by digesting with dilute acid and (2) analyzed using SW846 6010/7470/7471 for metals. Quantitation of metals will be conducted using external and internal calibration standards as dictated by the method. Samples results will be reported in mg/kg dry weight for solid and waste matrices and μg/L in aqueous matrices.

If modifications to any of the listed methods are required to achieve lower detection limits or to mitigate matrix interference, the laboratory will (1) document, in the case narrative, any modifications to the methods and (2) prepare all associated QC samples with identical modifications.

B4.2 Volatile Organic Compounds

VOCs will be analyzed in all matrices collected for this investigation using gas chromatography and mass spectrometry (GC/MS). Contaminants will be (1) transferred from the sample matrix to the gaseous phase by purging with inert gas and (2) analyzed under SW846 8260B for low-concentration waters. Quantitation of VOCs will be conducted using external and internal calibration standards as dictated by the method. Samples will be reported in micrograms per kilogram (µg/kg) dry weight for solid and waste matrices and µg/L in aqueous matrices.

If modifications to any of the listed methods are required to achieve lower detection limits or to mitigate matrix interference, the laboratory will (1) document, in the case narrative, any modifications to the methods and (2) prepare all associated QC samples with identical modifications.

B4.3 Semi Volatile Organic Compounds

SVOC will be analyzed in all matrices for this investigation using GC/MS. Contaminants will be transferred from the sample matrix to a solvent phase and analyzed using organic solvents according to SW-846 8270C for low-concentration waters. The resulting solvent extract will be analyzed using GC/MS. Quantitation of SVOCs will be conducted using external and internal calibration standards as dictated by the method. Samples will be reported in µg/kg dry weight for solid and waste matrices and in µg/L for aqueous matrices.

If modifications to any of the listed methods are required to achieve lower detection limits or to mitigate matrix interference, the laboratory will (1) document, in the case narrative, any modifications to the methods and (2) prepare all associated QC samples with identical modifications.

B4.4 Pesticides/Herbicides and PCB

Pesticides/Herbicides and PCBs will be analyzed in all matrices for this investigation using GC/ECD. Contaminants will be transferred from the sample matrix to a solvent phase and analyzed using organic solvents according to SW-846 3510 for low-concentration waters. The resulting solvent extract will be analyzed using GC and confirmed by dual column confirmation. Pesticides/herbicides and PCBs will be quantified using external calibration standards as dictated by the method. Samples will be reported in µg/kg dry weight for solid and waste matrices and in µg/L for aqueous matrices. PCBs will be reported as Aroclors. Congener analysis of PCBs is not proposed for the Phase I investigation because screening levels are reported as Aroclors. Congener analysis of PCBs is proposed for the Phase II investigation pending evaluation of the Phase I data.

PCBs are not suspected of being widely distributed at the site, and may ultimately be shown to be absent from most areas. A determination has been made that the Phase I RI would assess the Aroclors as part of the pesticides/PCB analytical suite. Should the Phase I RI provide evidence that PCBs are present, then Phase II RI sampling will assess the concentrations of individual PCB congeners.

If modifications to any of the listed methods are required to achieve lower detection limits or to mitigate matrix interference, the laboratory will (1) document, in the case narrative, any modifications to the methods and (2) prepare all associated QC samples with identical modifications.

B5 QUALITY CONTROL

This section presents QC requirements relevant to analysis of environmental samples that shall be followed during all analytical activities for fixed-base, mobile, and field laboratories producing definitive data. The purpose of this QC program is to produce data of known quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for ongoing control and evaluation of data quality measurements through the use of QC materials.

Laboratory QC samples (e.g., blanks and laboratory control samples) will be included in the preparation batch with the field samples. An analytical batch is a number of samples (not to exceed 20 environmental samples) that are similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents. The term "analytical batch" also extends to cover samples that do not need separate extraction or digestion (e.g., volatile analyses by purge and trap) and is the number of samples (not to exceed 20 environmental samples) that are similar in composition (matrix) and analyzed sequentially. The identity of each analytical batch shall be unambiguously cross-referenced and reported with the associated sample analyses so that a reviewer can identify the QC samples and the associated environmental samples. All references to the analytical batch in the following sections and tables in this QAPP refer to the analytical batch as defined here.

The type of QC samples and the frequency or use or these samples are discussed below and provided on Table 6.

B5.1 Field Quality Control Samples

Field QC samples will be collected and analyzed to assess the quality of data that are generated by sampling activities. These samples will include (1) replicate measurements (for field screening analyses only), (2) laboratory QC samples collected in the field, (3) field duplicates, (4) equipment rinsates, and (5) trip blanks, and (6) temperature blanks. QC samples collected in the field for fixed-laboratory analysis are presented in Table 3.

QC checks for field screening analysis will consist of calibration checks of field instrumentation to a QC standard to determine the accuracy of the measurement analyzed at the beginning of each day of analysis and subsequently after every 10-sample measurements. The precision of field measurements will be checked by taking replicate measurements every 10-samples.

MS, MSD, and matrix duplicate (MD) samples are laboratory QC samples that are collected in the field. For solid matrices, MS/MSD samples require no extra volume, unless specifically required by fixed laboratories. For aqueous samples, MS/MSD samples require three times the normal volume for organic analyses and two times the normal volume for inorganic analyses.

Trip blanks are used to assess the potential for sample contamination during handling, shipment, and storage. Trip blanks for liquid samples are bottles that are filled with organic-free water. The trip blanks are (1) sealed and transported to the field, (2) stored with empty sample bottles and then with the investigative samples throughout the field effort, and (3) returned to the laboratory with the investigative samples for analysis. Trip blanks are never opened in the field. One trip blank is included in every shipping cooler of aqueous samples sent to the analytical laboratory to be analyzed for VOCs as listed in Table 3.

Field duplicates are independent samples that are collected as close as possible, in space and time, to the original investigative sample. Immediately following collection of the original sample, the field duplicates are collected using the same collection method. Sampling personnel will be careful to collect the field duplicates as close as possible to the location of the original samples. Field duplicates can measure the influence of sampling and field procedures on the precision of an environmental measurement. They can also provide information on the heterogeneity of a sampling location. Field duplicates will be collected at a frequency as listed in Table 3.

Equipment rinsate blanks are collected when nondedicated or nondisposable sampling equipment is used to collect samples and put the samples into containers. These blanks assess the cleanliness of the sampling equipment and the effectiveness of equipment decontamination. Equipment rinsate blanks are collected by pouring analyte-free water over the decontaminated surfaces of sampling equipment that contacts sampling media. Equipment rinsate blanks are collected after sampling equipment has been decontaminated, but before the equipment is reused for sampling. If nondedicated or nondisposable equipment is used, equipment rinsate blanks will be collected at a frequency as listed in Table 3.

Temperature blanks are containers of deionized or distilled water that are placed in each cooler shipped to the laboratory. Their only purpose is to provide a container to be used for testing the temperature of the samples in the respective cooler.

B5.2 Laboratory Control Sample

The LCS is analyte-free water (for aqueous analyses) or Anhydrous Sodium Sulfate (for soil analyses) spiked with the analytes listed in the SOW and associated tables for the method. The LCS shall be spiked at the levels appropriate for the analysis and the laboratory SOP. The LCS shall be carried through the complete sample preparation and analysis procedure.

The LCS is used to evaluate each analytical batch and to determine if the method is in control. The LCS cannot be used as the continuing calibration verification. One LCS shall be included in every analytical batch, or analyzed every 30 days, whichever is more frequent. The performance of the LCS is evaluated against the QC acceptance limits given in the tables in the SOW or statistically derived limits from the laboratory database.

Whenever an analyte in an LCS is outside the acceptance limit, corrective action shall be performed. After the system problems have been resolved and system control has been re-established, all samples in the analytical batch shall be reanalyzed for the out-of-control analyte(s). When an analyte in an LCS exceeds the upper or lower control limit and no corrective action is performed or the corrective action was not effective, the appropriate flag shall be applied to all affected results. For organic analysis, surrogate and internal standards shall be evaluated to determine whether the data for individual samples is within acceptance limits and whether corrective action is required.

B5.3 Matrix Spike / Matrix Spike Duplicate

A MS and MSD is an aliquot of sample spiked with known concentrations of the analytes listed in the SOW for the method. The spiking occurs prior to sample preparation and analysis. The MS and MSD shall be spiked at the levels appropriate for the analysis and the laboratory SOP. The MS/MSD shall be designated on the chain of custody. The MS/MSD is used to document the bias of a method due to sample matrix. A minimum of one project sample shall be designated as an MS and MSD and shall be spiked and analyzed as part of every 20 project samples.

The performance of the MS and MSD is evaluated against the QC acceptance limits given in the tables or statistically derived limits from the laboratory database. If either the MS or the MSD is outside the QC acceptance limits, the analytes in all related project samples shall be qualified according to the data flagging criteria.

B5.4 Surrogates

Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples.

Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

Whenever a surrogate recovery for compounds with similar retention times is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been re-established, the sample shall be re-extracted / re-digested and reanalyzed. If corrective actions are not performed or are not effective, the appropriate validation flag will be applied to the sample results.

B5.5 Internal Standards

Internal standards (ISs) are measured amounts of certain compounds added after preparation or extraction of a sample. They are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects. IS shall be added to environmental samples, controls, and blanks, in accordance with the method requirements. When the IS results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been re-established, all samples analyzed while the system was malfunctioning shall be reanalyzed. If corrective actions are not performed or are ineffective, the appropriate validation flag shall be applied to the sample results.

B5.6 Retention Time Windows

Retention time windows are used in GC and high performance liquid chromatography (HPLC) analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days.

When the retention time is outside of the acceptance limits, corrective action shall be performed. After the system problems have been resolved and system control has been re-established, all samples analyzed since the last acceptable retention time check shall be reanalyzed. If corrective actions are not performed, the appropriate validation flag shall be applied to the sample results.

B5.7 Interference Check Sample

The interference check sample (ICS), used in ICP analyses only, contains both interfering and analyte elements of known concentrations. The ICS is used to verify background and inter-element correction factors. If the instrument is capable of showing over correction, as a negative, then ICS will not be required. Also, if analyses of ICS on 5 consecutive days are within acceptance criteria, then analysis of ICS can be performed on a weekly basis. After any system problems have been resolved and system control has been re-established, the ICS shall be reanalyzed. If the ICS results are acceptable, all affected samples shall be reanalyzed. If corrective action is not performed or the corrective action was ineffective, the appropriate validation flag shall be applied to all affected results.

B5.8 Method Blank

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank shall be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

The presence of analytes in a method blank at concentrations equal to or greater than the RLs indicates a need for corrective action. Corrective action shall be performed to eliminate the source of contamination prior to proceeding with analysis. After the source of contamination has been eliminated, all samples in the analytical batch shall be re-extracted / re-digested and reanalyzed. No analytical data shall be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples and corrective actions are not performed or are ineffective, the appropriate validation flag shall be applied to the sample results.

B5.9 Field Blank

The field blank consists of American Society for Testing and Materials (ASTM) Type II reagent grade water poured into a volatile organic compound (VOC) sample vial at the sampling site (in the same vicinity as the associated samples). It is handled like an environmental sample and transported to the laboratory for analysis. Field blanks are prepared only when VOC samples are taken and are analyzed for all VOC analytes.

Field blanks are used to assess the potential introduction of contaminants from field sources (e.g., gasoline motors in operation, etc.) to the samples during sample collection. Field blanks will not be used on this project.

B5.10 Equipment Blank

An equipment blank is a sample of ASTM Type II reagent grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. If equipment is dedicated, no equipment blank is required.

Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. Collection of equipment blanks shall be at a frequency of one equipment blank per equipment type per medium per day. Equipment blanks shall be collected immediately after the equipment has been decontaminated. The equipment blank should be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

When an analyte is detected in the equipment blank the appropriate validation flag shall be applied to all sample results from samples collected.

B5.11 Trip Blank

Trip blanks are used to assess the potential introduction of contaminants from sample containers. The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes or during the transportation and storage procedures.

When an analyte is detected in the trip blank the appropriate validation flag shall be applied to all sample results from samples in the cooler with the affected trip blank. One trip blank shall accompany each cooler of samples sent to the laboratory for analysis of VOCs.

B5.12 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest.

For samples collected for laboratory analysis, field duplicates will be collected at a rate of 10 percent of the total number of samples collected during each day of sampling for each sample matrix type. The number of samples will be rounded up to the next increment of 10, such that 21 samples would require three duplicates if collected within three days. At least one field duplicate will be collected per day of sampling and will be packaged and sent to the laboratory for analysis with the other samples of the same sample matrix type.

B5.13 Field Replicates

A field replicate sample, also called a split, is a single sample divided into two equal parts for analysis. The sample containers are assigned an identification number in the field such that they cannot be identified as replicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field replicate samples prior to the beginning of sample collection.

Replicate sample results are used to assess precision for evaluating the homogeneity of composite samples, the laboratory precision, and/or the performance between two or more laboratories. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the composting process required to obtain uniform samples could result in loss of the compounds of interest.

Field replicates are not planned for this project.

B5.14 Holding Time Compliance

All sample preparation and analysis shall be completed within the method-required holding times. The holding time begins at the time of sample collection. Some methods have more than one holding time requirement (e.g., methods for pesticides, semi-volatiles, etc.). The preparation holding time is calculated from the time of sample collection to the time of completion of the sample preparation process as described in the applicable method, prior to any necessary extract cleanup and/or volume reduction procedures. If no preparation (e.g., extraction) is required, the analysis holding time is calculated from the time of sample collection to the time of completion of all analytical runs, including dilutions, second column confirmations, and any required reanalyses. In methods requiring sample preparation prior to analysis, the analysis holding time is calculated from the time of preparation completion to the time of completion of all analytical runs, including dilutions, second column confirmations, and any required reanalyses.

Holding times given in hours (i.e. 24 hours, 48 hours) are calculated to the hour. Holding times given in days (i.e. 7 days, 28 days) are calculated to the end of the appropriate calendar day.

B5.15 Confirmation

Quantitative confirmation of results at or above the RLs for samples analyzed by GC or HPLC shall be required and shall be completed within the method-required holding times. For GC methods, a second column is used for confirmation. For HPLC methods, a second column or a different detector is used. The result of the first column/detector shall be the result reported. If holding times are exceeded and the analyses are performed, the results shall be flagged.

B5.16 Common Data Quality Indicators

Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) parameters are indicators of data quality. The end use of the measurement data should define the necessary PARCC parameters. Numerical precision, accuracy, and completeness goals will be established in each FSP and will aid in selecting the measurement methods.

B5.16.1 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among: independent measurements as the result of repeated application of the same process under similar conditions. *Analytical* precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. *Total* precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the RPD between the duplicate sample results. For replicate analyses, the relative standard deviation (RSD) is determined.

B5.16.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systematic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS or matrix spike sample to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed. Analysis of performance evaluation (PE) samples shall also be used to provide additional information for assessing the accuracy of the analytical data being produced.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements.

B5.16.3 Representativeness

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations. Decisions regarding sample locations and numbers and the statistical sampling design are documented in the FSP.

B5.16.4 Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix and analyte combination. Completeness shall be calculated in two ways: 1) The number of valid individual analyte results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set for risk assessment; and 2) the number of valid sample points divided by the number of planned sample points, expressed as a percentage, determines the completeness of the data set for remedial investigation/feasibility studies.

For completeness requirements, valid results are all results not qualified with an "R" flag. The requirement for completeness is 95 percent for aqueous samples and 90 percent for soil samples. For any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported. Kleinfelder will note in the QA report any significant anomalies in the data set.

The formula for the calculation of completeness for risk assessment is presented below:

$$\%\ \textit{Completeness} = \frac{\text{number of valid results}}{\text{number of possible results}}$$

The formula for the calculation of completeness of a data set is presented below:

$$\%\ \textit{Completeness} = \frac{\text{number of valid sample points}}{\text{number of planned sample points}}$$

B5.16.5 Comparability

Comparability is the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Analysis of performance evaluation samples and reports from audits will also be used to provide additional information for assessing the comparability of analytical data produced among subcontracting laboratories. Historical comparability will be achieved through consistent use of methods and documentation procedures throughout the project.

B6 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

This section outlines testing, inspection, and maintenance procedures for field equipment and instruments and for laboratory instruments. Kleinfelder will lease equipment through a national account supply agreement. This section discusses general requirements that apply to field and laboratory equipment, and field specific and laboratory-specific requirements.

B6.1 General Requirements

Testing, inspection, and maintenance methods and frequency will be based on (1) the type of instrument; (2) its stability characteristics; (3) the required accuracy, sensitivity, and precision; (4) its intended use, considering project-specific DQOs; (5) manufacturer's recommendations; and (6) other conditions that affect measurement or operational control. For most instruments, preventive maintenance is performed in accordance with procedures and schedules recommended in (1) the instrument manufacturer's literature or operating manual or (2) SOPs associated with particular applications of the instrument.

In some cases, testing, inspection, and maintenance procedures and schedules will differ from the manufacturer's specifications or SOPs. This can occur when a field instrument is used to make critical measurements or when the analytical methods that are associated with a laboratory instrument require more frequent testing, inspection, and maintenance.

B6.2 Field Equipment and Instruments

Kleinfelder will use leased field equipment and instruments. Leased field equipment and instruments will be identified uniquely as the property of the respective vendor. The vendor will be responsible for thoroughly checking and calibrating field equipment and instruments before they are shipped or transported to the field. Copies of testing, inspection, and maintenance procedures will be shipped to the field with the equipment and instruments. After the equipment and instruments arrive in the field, the site manager(s) will assume responsibility for testing, inspection, and maintenance.

After arrival in the field, field equipment and instruments will be inspected for damage. Damaged equipment and instruments will be replaced or repaired immediately. Battery-operated equipment will be checked to ensure full operating capacity; if needed, batteries will be recharged or replaced. Critical spare parts will be kept on site to minimize equipment downtime. Examples of critical spare parts are tape, paper, pH probes, electrodes, and batteries. Delays in the field schedule should be prevented by having back-up instruments and equipment available on site or available for shipment to the site within one day.

Following use, field equipment will be decontaminated properly before it is returned to its source. When the equipment is returned, copies of any field notes regarding equipment problems will be included so that problems are not overlooked and any necessary equipment repairs are performed.

B6.3 Laboratory Instruments

ALGC has a preventive maintenance program that addresses (1) testing, inspection, and maintenance procedures and (2) the maintenance schedule for each measurement system and required support activity. The program is documented by an SOP for each analytical instrument that is to be used.

Some of the basic requirements and components of the program are as follows:

- As a part of its QA/QC program, each laboratory will conduct a routine preventive maintenance program to minimize instrument failure and other system malfunction.
- An internal group of qualified personnel will service and repair instruments, equipment, tools, and gauges. Alternatively, manufacturers' representatives may provide scheduled instrument maintenance and emergency repair under a repair and maintenance contract.
- The laboratory will perform instrument maintenance on a regularly scheduled basis. The scheduled service of critical items should minimize the downtime of the measurement system. The laboratory will prepare a list of critical spare parts for each instrument. The laboratory will request the spare parts from the manufacturer and will store them.
- Testing, inspection, and maintenance procedures described in laboratory SOPs will be performed in accordance with manufacturer's specifications and the requirements of the specific analytical methods that are used.
- All maintenance and service must be documented in service logbooks to provide a history of maintenance records. A separate service logbook should be kept for each instrument.
- All maintenance records will be traceable to the specific instrument, equipment, tool, or gauge.
- The laboratory will maintain and file records that are produced as a result of tests, inspections, or maintenance of laboratory instruments. These records will be available for review by internal and external laboratory system audits.

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

B7.1 Field Equipment

Equipment that is used to collect field samples or take field measurements at the Site will be maintained and calibrated with sufficient frequency and in such a manner that the accuracy and reproducibility of results are consistent with the manufacturer's specifications and with project-specific, screening-level DQOs.

Upon arrival of the field sampling and measurement equipment, the site manager will examine it to verify that it is in good working condition. The manufacturer's operating manual and instructions that accompany the equipment will be consulted to ensure that all calibration procedures are followed.

Measuring and testing equipment may be calibrated either internally—by using in-house reference standards—or externally—by agencies, manufacturers, or commercial laboratories. Calibration records will contain a reference identifying the source of the procedure and, where feasible, the actual procedure.

Each item of measuring and testing equipment will also be accompanied by an equipment use log. The equipment use log will be kept current and may contain the following information: (1) date of use, (2) times of use, (3) operating and assisting technicians, (4) calibration status, and (5) comments.

Assurance that properly calibrated equipment is used for measuring and testing is the responsibility of each team leader, who will confirm that properly calibrated equipment is used. Inspections may include a review of calibration records and procedures. These inspections will be conducted at least weekly, and the results of the inspections will be logged by the field technician. Personnel who use calibrated equipment are directly responsible for performing proper calibration and maintenance before use.

Documented and approved procedures will be used to calibrate measurement and test equipment. Whenever possible, widely accepted procedures will be used, such as those published by EPA or the respective equipment manufacturer.

Equipment that requires calibration will be identified uniquely by the equipment serial number or other adequate means. Whenever feasible, a tag will be affixed to the equipment; the tag will identify (1) the date of the most recent calibration, (2) the initials of the calibrating technician, and (3) the date of the next scheduled calibration. The site chemist will maintain a list of measurement equipment that requires frequent calibration.

The list will include the name and serial number of the equipment and its calibration frequency and status. As part of the established calibration procedure for each item of equipment, reference standards will be used for calibration. The reference standards will have known relationships to nationally recognized standards. If there are no national standards, the basis for calibration will be documented. Equipment that fails calibration or becomes inoperable during use will be removed from service and replaced.

Periodic preventive maintenance is required for some equipment. The requirements for preventive maintenance will be documented in the equipment use log. Preventive maintenance will be recorded in the equipment use log as part of the operational procedure. Equipment manuals will be kept on file for reference purposes; however, a scheduled preventive maintenance program will be addressed in the equipment use log.

B7.2 Laboratory Equipment

Analytical instruments shall be calibrated in accordance with the analytical methods. All analytes reported shall be present in the initial and continuing calibrations, and these calibrations shall meet the acceptance criteria. Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards shall be traceable to standard materials.

Instrument calibration shall be checked using the analytes listed in the QC acceptance criteria for the method. This applies equally to multi response analytes. All calibration criteria shall satisfy SW-846 requirements at a minimum. The initial calibration shall be verified prior to the analysis of any environmental samples. The initial calibration verification solution shall be prepared using materials prepared independently of the calibration standards and at a different concentration than that of any of the initial calibration standards but still within the bounds of the calibration curve. Acceptance criteria for the calibration verification are presented in Section 5 and associated tables. Analyte concentrations are determined with either calibration curves or response factors (RFs). For gas chromatography (GC) and GC/MS methods, when using RFs to determine analyte concentrations, the average RF from the initial five-point calibration shall be used. The continuing calibration shall not be used to update the RFs from the initial five-point calibration. The continuing calibration verification cannot be used as the LCS.

B8 REQUIREMENTS FOR INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The PC has the primary responsibility for identifying the types and quantities of supplies and consumables that are needed for collecting data at the Site. The PC is also responsible for determining acceptance criteria for these items.

Supplies and consumables can be received at the Site. When supplies are received at the site the site manager will sort the supplies according to vendor, check packing slips against purchase orders, and inspect the condition of all supplies before the supplies are accepted for use on a project. If the supplies do not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order. In addition, a form will be completed describing the problem and circumstances, and noting the purchase order number of the item. Afterward, the item will be returned to the vendor for replacement or repair.

Procedures for receiving supplies and consumables in the field are similar to those for receiving supplies and consumables at a distribution center. Upon receipt of the items, the site manager will inspect them in accordance with the acceptance criteria. Any deficiencies or problems will be noted in the field logbook. Deficient items will be returned for immediate replacement.

B9 NONDIRECT MEASUREMENTS

For this project, Kleinfelder anticipates acquiring data from nondirect measurements such as databases, spreadsheets, and literature files. Files from regulatory agencies and eyewitness accounts will be used.

B9.1 Computer Software and Programs

Each computer software package and program that is used will be verified as applicable to the requirements of the work item. Approval of the software and subsequent programs will be given by the coder; the user and the checker, as applicable; and, ultimately, the appropriate project management personnel.

B10 DATA MANAGEMENT

Data for this project will be obtained from a combination of sources, including field measurements and laboratories. The data-gathering process requires a coordinated effort and will be conducted by project staff members in conjunction with all potential data producers. The data will be obtained from the analytical service provider, when appropriate, in the form of an electronic data deliverable, in addition to the required hard copy analytical data package. Formal verification (or validation) of data will be conducted before associated results are presented or are used in subsequent activities.

Data tracking is essential to ensure timely, cost-effective, and high-quality results. Data tracking begins with sample chain of custody. When the analytical service provider receives custody of the samples, the provider will send a sample acknowledgment to Kleinfelder. The sample acknowledgment will confirm sample receipt, condition, and required analyses.

As a part of the data validation process, electronic data deliverables will be reviewed against hard copy deliverables to ensure accurate transfer of data. In addition, the hard copy will be evaluated for errors in the calculation of results. After the data validation, qualifiers can be placed on the data to indicate the usability of the data. These qualifiers will be placed into an electronic data file. Upon approval of the data set with the appropriate data qualifiers, the electronic data will be released to the project coordinator for reporting.

Following data validation and release of data, the project manager will have the data for project report preparation. As a part of the final report QC review procedures, the data will be checked again by technical reviewers or a QC coordinator to verify its accuracy in the report.

In addition to the final report, all analytical data, in the form in which they are obtained from the analytical service provider, will be archived with the final project file in the document control center.

C1 ASSESSMENT AND RESPONSE ACTIONS

Sampling and analysis are performed in accordance with the following:

- Performance and system audits:
  - Audit personnel;
  - Audit scope of work;
  - Audit frequencies; and
  - Audit reports.
- Corrective action:
  - Sample collection and field measurements; and
  - Laboratory analyses;

Nonconforming items and activities are those that do not meet the project requirements, procurement document criteria, and approved work procedures. Nonconformance may be detected and identified by the following personnel:

- Project personnel—During field operations, supervision of subcontractors, and field Inspections;
- Testing personnel—During preparation for and performance of tests, equipment calibration, and QC activities; and
- QA personnel—During the performance of audits, surveillance, and other QA activities

Each nonconformance that affects quality will be documented by the person who identifies or originates the nonconformance. Documentation of nonconformance will include the following components:

- Description of nonconformance;
- Identification of personnel who are responsible for correcting the nonconformance and, if verification is required, for verifying satisfactory resolution;
- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted; and
- Proposed schedule for completing corrective action and the corrective action taken Nonconformance documentation will be made available to the project manager, QA manager, and subcontractor management personnel, as appropriate.

The field manager and QA personnel, as appropriate, are responsible for notifying the project coordinator and the QA manager of the nonconformance. In addition, the project coordinator and the site manager, as appropriate, will be notified of significant nonconformances that could affect the results of the work. The project coordinator is responsible for determining whether notification of EPA is required.

The completion of corrective actions for significant nonconformances will be documented by QA personnel during future auditing activities. Any significant recurring nonconformance will be evaluated by project and QA personnel, as appropriate, to determine its cause. Appropriate changes will be instituted, under corporate or project procedures, to prevent recurrence. When such an evaluation is performed, the results will be documented.

C2 REPORTS TO MANAGEMENT

Effective management of environmental data collection operations requires timely assessment and review of measurement activities. It is essential that open communication, interaction, and feedback be maintained among all project participants, including the EPA Region 6 RPM, QA manager, PC, technical staff, and laboratory subcontractors.

Quarterly reports will be written by the QA Officer that address the following areas:

- Results of QA audits and other inspections, including any quality improvement opportunities that have been identified for further action;
- Instrument, equipment, or procedural problems that affect QA;
- Subcontractor performance issues;
- Corrective actions;
- Status of previously reported activities and continuous quality improvement initiatives; and
- Work planned for the next reporting period.

D1 DATA REVIEW AND REDUCTION REQUIREMENTS

Data reduction and review are essential functions for preparing data that can be used effectively to support project decisions and DQOs. These functions must be performed accurately and in accordance with EPA approved procedures and techniques. Data reduction includes all computations and data manipulations that produce the final results that are used during the investigation. Data review includes all procedures that field or laboratory personnel conduct to ensure that measurement results are correct and acceptable in accordance with the QA objectives that are stated in this QAPP. Field and laboratory measurement data reduction and review procedures and requirements are specified in previously discussed field and laboratory methods, SOPs, and guidance documents.

Field personnel will record, in a field logbook and/or on the appropriate field form, all raw data from chemical and physical field measurements. The PC has the primary responsibility for (1) verifying that field measurements were made correctly, (2) confirming that sample collection and handling procedures specified in the project-specific QAPP were followed, and (3) ensuring that all field data reduction and review procedures requirements are followed. The project manager is also responsible for assessing preliminary data quality and for advising the data user of any potential QA/QC problems with field data. If field data are used in a project report, data reduction methods will be fully documented in the report.

Reduction of field data will be verified by reviewing field logbooks against reported field data. Checks will be performed before results are presented. If unchecked results are presented or used, transmittals or subsequent calculations will be marked DRAFT until the results have been checked and determined to be correct Data reduction (100 percent for field analyses) and resulting summaries, tables, and graphs will be checked. This will include computer input if reduction is performed by computer. Data sheets will be complete and will address requested information.

The laboratories will complete data reduction for chemical and physical laboratory measurements and will complete an in-house review of all laboratory analytical results. The laboratory QA manager will be responsible for ensuring that all laboratory data reduction and review procedures follow the requirements that are stated in this QAPP. The laboratory QA manager will also be responsible for assessing data quality and for advising the QA manager of possible QA/QC problems with laboratory data.

D2 VALIDATION AND VERIFICATION METHODS

This section outlines the basic data validation procedures that will be followed for all field and laboratory measurements. The following subsections identify personnel who are responsible for data validation and the general data validation process and EPA data validation guidance that will be followed.

D2.1 Data Validation Responsibilities

The QA manager has primary responsibility for coordinating data validation activities and will validate 10 percent of all subcontracted laboratory data for investigation and remedy samples. Data validation and review will be completed by one or more experienced data reviewers.

D2.2 Data Validation Procedures

The validity of a data set is determined by comparing the data with a predetermined set of QC limits, which are provided in Sections A9 and B5 of this QAPP. Data reviewers will conduct a systematic review of the data for compliance with established QC limits (such as sensitivity, precision, and accuracy), on the basis of spike, duplicate, and blank sampling results that are provided by the laboratory. The data review will identify any out-of-control data points or omissions. Data reviewers will evaluate laboratory data for compliance with the following information:

- Method and project-specific analytical service requests;
- Holding times;
- Initial and continuing calibration acceptance criteria;
- Field, trip, and method blank acceptance criteria;
- Surrogate recovery;
- Field duplicates and MS and MSD acceptance criteria;
- MD precision;
- LCS accuracy;
- Other laboratory QC criteria specified by the method or on the project-specific analytical service request form;
- Compound identification and quantitation; and
- Overall assessment of data, in accordance with project-specific objectives.

General procedures in the SW-846 guidelines will be modified, as necessary, to fit the specific analytical method that is used to produce the data. In all cases, data validation requirements will depend on DQO levels that are defined in Section A9, reporting requirements that are defined in Section A10, and data deliverables that are requested from the laboratory, as discussed in Section A10.

D3 Reconciliation with Data Quality Objectives

The main purpose of a QA system is to define a process for collecting data that are of known quality, are scientifically valid, are legally defensible, and fully support any decisions that will be based on the data.

To achieve this purpose, the QAPP requires that DQOs be fully defined. All other parts of the QA system must then be planned and implemented in a manner that is consistent with the DQOs. QA system components that follow directly from the DQOs include documentation and reporting requirements; sample process design and sampling methods requirements; analytical methods and analytical service requests; QC requirements; and data reduction and validation and reporting methods.

After environmental data have been collected, reviewed, and validated, the data will undergo a final validation to determine whether the DQOs specified in the QAPP have been met. Where data are used in the forthcoming risk assessments, the DQA will be conducted during the risk assessments.

First, the DQA process involves verifying that the data have met the assumptions under which the data collection design and DQOs were developed and taking appropriate corrective action if the assumptions have not been met. Second, the DQA process evaluates the extent to which the data support the decision that must be made so that scientifically valid and meaningful conclusions can be drawn from the data.